GROUND WATER AS RELATED TO SURFACE WATER
IN IRRIGATION DIVISION 1, WATER
DISTRICT 6 OF THE STATE OF COLORADO

by

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Ground Water as Related to Surface Water in Irrigation Division 1, Water District 6 of the State of Colorado
Thesis directed by Associate Professor Charles V. Hallenbeck, Jr.

This thesis is a study of the effects of recent tributary ground water appropriations upon the older surface water appropriation in Irrigation Division 1, Water District 6, of the State of Colorado. While senior surface water appropriations are being administered, junior tributary underground water appropriations are not.

Any departure from the strict application of the doctrine of priority of appropriations as between surface water and tributary ground water appropriations is in direct conflict with the constitutional provisions of Colorado, and enriches the junior appropriators of tributary ground water at the expense of senior appropriators of surface rights.

The study includes a brief history of laws regulating water rights, and elements of ground water hydrology; data collected through a post card survey and personal interviews; current factors in accelerated growth; and general conclusions as to the results of the study.

A study was made of the 1100 wells in the District registered with the State, and of the capacity of these wells. These figures were compared with information collected from the post card survey and personal interviews, to show probable usage of ground water.

Charts, graphs, and tables, are used to illustrate the author's contention that approximately one-half of the 1100 registered wells are taking water belonging to the natural streams in the District. In addition to the registered wells there exists a large but undetermined number of unregistered wells that are also taking water tributary to natural streams.

This abstract is approved as to form and content.

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CHAPTER I

INTRODUCTION

Water is one of man's most vital resources. Particularly in the arid west, and more recently in New York City and in the New England States, the problem of an adequate water supply is acute. Because of the highly developed municipal water supply works, the average citizen takes for granted a seemingly never-ending source of water. Only when he must ration his water, or watch his crop fail due to a lack of water, does he become aware that his water resource is not inexhaustible.

The average daily consumption of water in the United States is 125 gallons per day for every man, woman, and child.[1] In the arid western states the consumption is higher due to increased usage for irrigation of lawns and crops, and due to losses by evaporation. For example, in

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[1]Walter A. Weers, Lecture to Class in Sanitary Engineering I, University of Colorado, Spring Semester, 1965.

the city of Boulder, Colorado, the average daily consumption is 148 gallons per day per capita.[2]

Because the consumption rate is larger, and the water resources are smaller in arid regions, than in the United States as a whole, there exists a strong need for a fair administration of water rights. In Irrigation Division 1, Water District 6, of the State of Colorado, one problem of water appropriation deals with the proper allocation of water between surface appropriators and underground appropriators. The purpose of this thesis is to:

1. Discuss the administration, or lack of administration, of the surface water appropriations and tributary underground water appropriations.
2. Indicate the effects of this administration on the water appropriations.
3. Compile the records which indicate the extent of the unadministered appropriations and check these records against actual conditions.

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[2]This figure is based on city of Boulder, Water Diversion Records 1948 - 1966, and was calculated from the average water consumption in 1964, a very dry year, and 1965, a very wet year.

The water appropriation laws of the state of Colorado are based on a doctrine of "first-in-time, first-in-right." This means that a person who first puts water to a beneficial use, and makes a legal claim to such use, has the right to the amount of water claimed over all other claims for water from the same source at a later time.

Most of the usable surface water appropriations have priorities dating from 1859 - 1875, whereas many of the underground appropriations were established more recently. In fact, not until 1957 did there exist a law for the registration of wells in the state.

The major user of domestic water in Water District 6 is the city of Boulder, which derives all of its water supply from surface appropriations. Many individuals who live in dwellings which are not supplied by the Boulder water system derive their water supply from underground appropriations. This water is either from individual wells, or from private systems of wells and distribution lines. The development of an increasing number of wells in more recent years makes the problem of water appropriations more acute.

In addition, by granting housing loans and issuing building permits, various governmental agencies, both federal and local, are giving tacit approval for the

development of these wells without full knowledge of the consequences. The prospective home builder, with the knowledge that the governmental agencies have given their approval, builds his house and drills a well for water supply. The legal weakness of his claim to water is usually unknown to him.

An illustrative example of the problem is shown in Figure 1. This figure shows a series of hypothetical ditches taking water from Boulder Creek, the approximate amounts of water that the ditches can call upon, the priority numbers, and the probable return flow to the stream if no wells existed.

Assume that there exists 35 cfs in the stream at # 4 headgate and that 10 cfs are diverted, leaving 25 cfs in the creek. At priority # 2 ditch 5 cfs are diverted and 2.5 cfs are returned to the stream, plus 5 cfs returned from priority # 4 ditch. This allows 27.5 cfs to flow to priority # 1 ditch where 25 cfs were diverted, and 2.5 cfs are returned above the # 3 headgate, leaving 5 cfs in the stream at that point. To satisfy its claim, priority # 3 ditch diverts the remaining 5 cfs. Thus, with no wells existing, all claims have been satisfied.

Now suppose certain wells are pumping water that is tributary to the streams. The water pumped by these wells comes from the following three sources. Well # 1 takes

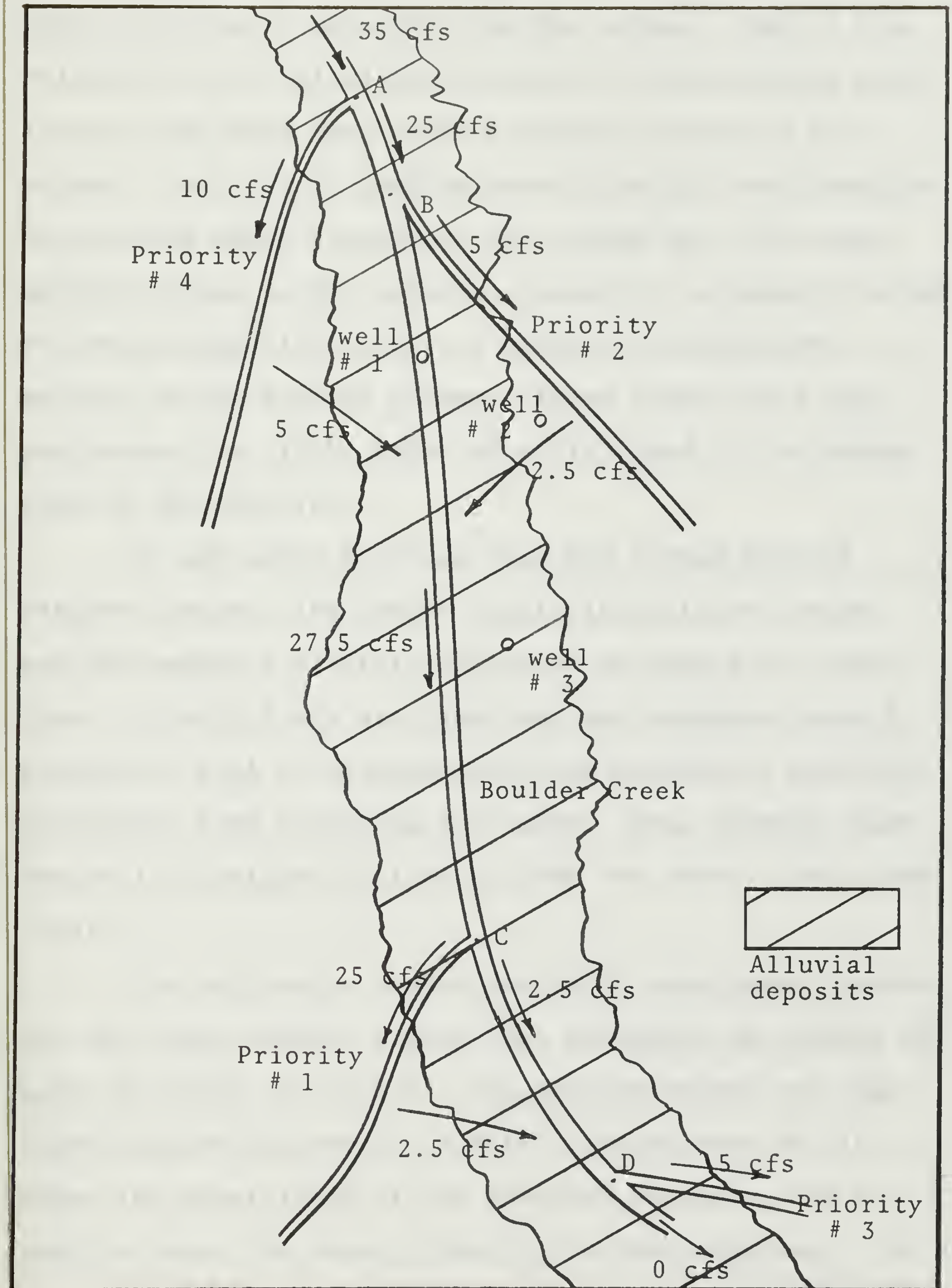

FIG. 1 - EXAMPLE OF APPROPRIATION PROBLEM

part of its water directly from the stream. Well # 2 is adjacent to an irrigation ditch and is intercepting water leaving the ditch that would otherwise return to the stream. Well # 3 is pumping water from the wide deposits of alluvium which constitute the stream bed. The water normally flows in the alluvial channel in a manner similar to the surface flow, and is a hidden or underground portion of the surface stream. These three wells are representative of the types of wells found in the plains area of the District.

If any water is taken from the stream and not returned above C the number 1 priority will not be met, and the number 4 priority will have to reduce its diversion. If only 5 cfs are taken and not returned above D, priority 3 will be without water and priority 4 would be prohibited from diverting any water. This example shows how wells developed as late as 1966 can affect 1860 water rights.

The only water rights currently being administered are the older surface rights that determine the amount of water diverted by ditches. The appropriations are regulated and administered by a Water Commissioner who is under the supervision of the Division Engineer, who in turn is under the supervision of the State Engineer. In a broad sense the streams, including the alluvial beds and

water tributary to the beds, are not being administered. The amount of water in the streams depends on the amount of precipitation that falls on the watershed, and man-made conditions. Dams have been built that change the natural stream flow and are used in the administration of ditch appropriations. Wells have been drilled, as in the preceding example, that alter the natural stream flow and are not administered. Considering the effects of these wells, the streams are not being administered -- only the ditch rights.

The water beneath the ground is a valuable resource, just as are mineral deposits and oil reservoirs, and should be utilized. The oil and mineral deposits are exhaustible resources, whereas ground water is a replenishible resource. The present water appropriations laws, if administered, could allow a large portion of this potential resource to go unused.

The limits of Irrigation Division 1, Water District 6, of the State of Colorado are established by a word description of the boundaries in Colorado Revised Statutes, 1963, and by a map prepared by the State Engineer in 1961, which shows the boundaries of all Irrigation Division and Water Districts. The limits of the district are shown on Plate 1 and are defined in Colorado Revised Statutes, 1963, 148-13-7, as:

> District No. 6 shall consist of all lands irrigated from ditches taking water from the Boulder and its tributaries, and Coal Creek.

This word description does not describe the area as represented by the map prepared by the State Engineer in 1961. For example, Community Ditch, which flows from Marshall Lake, leaves the eastern boundary of the district and flows into Weld County. Idaho Creek Ditch flows from Boulder Creek and leaves the district at the northeastern boundary and continues out of the district into Weld County. The State Engineer's map is of the entire state, and the exact boundaries are difficult to determine, due to the size and scale of the map, and due to the large width of the boundary lines.

Since no map of the exact area existed, seventeen topographic maps of 1:24,000 scale, 1 inch=2000 feet, from the United States Geological Survey, were used to establish the limits of the District.

From the use of this map it was determined which section, and parts of sections were to be used in the study. Knowing the limits of the district, it then became a matter of selecting from Colorado Water Conservation Board Basic-Data Release No. 17, 1964 only those wells within the boundaries of the district. This publication lists all wells registered in the state through 30 June 1964. There were eleven hundred wells registered in

District 6, and these appear in the appendix.

The number of wells registered with the State, and the capacity of these wells, was expanded upon from information obtained in a post card survey and from personal interviews. The returns from the post card survey appeared to be a very good representation of the registered wells, although only 26.5 per cent were returned. The area chosen for the personal interviews is not representative of the entire District, but was chosen because it is in an area that is representative of the present and of the expected future unregistered well development in the District.

Chapters explaining some of the aspects of the laws governing ground water appropriations, as well as some of the elements of ground water hydrology, are included so that the layman may better understand the problems, and so that persons with more knowledge of these subjects may obtain a brief review.

With the general attractiveness of the Boulder area, new industries and research facilities have caused a population growth of about 2000 people per year since 1952. Because of this growth, many housing developments have been constructed around the city. The largest development is to the east on the flood plains of Boulder Creek and South Boulder Creek.

In addition to the housing developments, both commercial enterprises and farms have a need for domestic water, and in most instances, for irrigation water as well. Irrigation water is used for lawns, and to supplement the direct flow or ditch rights of the farms. The bulk of this water is provided by wells. These wells derive their ground water supply by means of a well and a pump. Most, if not all, of this water is taken without the exercise of an adjudicated and administered priority. While the amount of water taken by this method is difficult to estimate, State well-registration records, a post card survey, and personal visits to selected areas indicate that as much as 50 cfs of water is being taken by wells in the district. With the anticipated well development of the plains area that figure could rise to as much as 110 cfs. Through graphs, charts, and figures it will be shown that much of the ground water pumped from wells is tributary to the streams in the area.

CHAPTER II

A BRIEF SUMMARY OF THE PERTINENT LAWS GOVERNING GROUND WATER APPROPRIATIONS

The sources of Colorado ground water laws are contained in Colorado Constitutional Provisions, Colorado Statutory Provisions, and Appropriations Doctrines as set forth by the courts of the state.

The Colorado Constitution, Article XVI, Section 5 states that the waters of streams are public property:

> The water of every natural stream, not heretofore appropriated, within the state of Colorado, is hereby declared to be the property of the public, and the same is dedicated to the use of the people of the State, subject to appropriation as hereafter provided.

Section 6 of the same constitutional article states that the right to divert unappropriated water for beneficial uses shall never be denied, and establishes an order of priority as domestic, agricultural, and manufacturing.

The Colorado Statutory Provisions dealing with ground water were revised and made effective May 17, 1965, under the "Colorado Ground Water Management Act." This act provided for the formation of Ground Water Management Districts and established "designated ground water" as separate from ground water adjacent to continuously

flowing natural streams [3] It also provided the state engineer with means of enforcing the new laws.[4]

Section 148-18-2(3) of the 1965 act states:

> The term 'Designated Ground Water' is that ground water which in its natural course would not be available for the fulfillment of decreed surface rights, or ground in areas not adjacent to a continuously flowing natural stream wherein ground water withdrawals have constituted the principal water usage for at least fifteen years preceding January 1, 1965, and which in both cases is within the boundaries, either geographic or geologic, of a designated ground water basin.

Further,

> . . . the state engineer shall make a determination as to whether or not exercise of the requested permit will materially injure the vested water rights of others.[5]

This latter quotation deals with laws requiring wells to be registered with the state engineer, with certain exceptions, as set forth in the Ground Water Act of 1957 and which is repeated again in the 1965 Act. The inclusion of these two items points out that the legislature is aware that ground water appropriations can be injurious to the water rights of others and that it is the duty of the State Engineer to administer ground water which is tributary to natural streams.

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[3] Colorado Revised Statutes, 1963, 148-18-5.

[4] Ibid., 148-18-9, and 148-11-12.

[5] Ibid., 148-18-36(2).

Riparian Rights, Springs, Seepage and Underground Water

The Colorado courts have upheld the belief that most water in the state will eventually find its way to some stream, and that it should, therefore, be considered as part of a natural stream when considering appropriation rights.[6]

The case of Nevius, et al. v. Smith, 86 Colo. 178, 279 Pac, 44, decided against the argument that percolation belongs to the owner of the soil. Further,

> . . . subsequent decisions adopted and applied the same rule to all underground water, which would ultimately reach and become tributary to a natural stream. And so to all such waters the law is definitely settled that the doctrine of priority of appropriation as established by the Colorado Constitution and Subsequent Statute in and thereof, applied to such water to the same extent and with the same force and effect as it did to surface water of the streams. That is, 'first in time, first in right.'[7]

From the "first in time, first in right" doctrine that the Colorado courts upheld, it can be seen that 1860 priorities are certainly senior to 1966 appropriations, if they are in fact dealing with the same water.

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[6]See Safranek et al. v. Town of Limon, 123 Colo. 330., p. 334.

[7]A. W. McHendire, "The Law of Underground Water," Volume 13, No. 1, The Rocky Mountain Law Review, p. 411. See also Crippen, Trustee, v. White et al. 28 Colo. 449, p. 459; Coffin et al. v. The Left Hand Ditch Company, 6 Colo. 443, p. 447; Black et al. v. Taylor et al., 128 Colo. 449, p. 459; The Town of Genoa v. Gilbert O. Westfall, 141 Colo. 533, p. 547.

Domestic Use of Water

Section 6 of Article XVI of the Constitution recognizes a preference for the domestic use of water over other uses. However, while the "first in time, first in right' doctrine is upheld by the courts, and allows a domestic use to have a priority over other uses, it does require a just compensation to those whose rights are affected by "domestic usage."[8]

It is provided in Colorado Revised Statutes 147-2-6 that:

> . . . water claimed and appropriated for domestic purposes shall not be employed or used for irrigation or for application to land or plants in any manner to any extent whatever.

Statute 147-2-7 makes a violation of the above article a misdemeanor, subject to a fine of not less than fifty nor more than two hundred dollars, for each day of improper application of water. That this law is being violated will be discussed later in more detail. However, to the author's knowledge, no court action based on this statute has reached Colorado courts.

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[8]See The Montrose Canal Company et al. v. The Loutsenhizer Ditch Company et al., 23 Colo. 233, p. 237; Town of Sterling et al. v. The Pawnee Ditch Extension Company, 42 Colo. 421, p. 426; Black et al. v. Taylor et al. 128 Colo. 449, p. 456.

Natural Streams Defined

Two court cases[9] have established that, owing to the high elevation of portions of the state and the general arid conditions, ". . . a large number of natural streams in the state are, and always have been, dry during a portion of the year,"[10] thus making all tributaries and streams draining into other streams, "natural streams."

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[9]See In Re German Ditch and Reservoir Company, 56 Colo. 252, p. 270; Strickler v. City of Colorado Springs, 16 Colo. 61, p. 67.

[10]See In Re German Ditch and Reservoir Company, 56 Colo. 252, p. 270.

CHAPTER III

SOME ELEMENTS OF GROUND WATER HYDROLOGY

Ground water hydrology is that branch of hydrology concerning the occurrence and movement of water within the geological strata of the earth. In this study, ground water hydrology is of importance, and an understanding of some of the basic principles would be of benefit.

The idea that ground water originates by the process of evaporation-condensation-precipitation is relatively new. As late as the close of the seventeenth century, it was still thought that ground water could not be obtained from rainfall, because the quantity of rainfall was insufficient, and that the earth was too impervious to allow rainwater to exist very far beneath the surface.[11] Water found in the ground was based on an ocean-fed-theory, with variations as to the causes of water movement.

In the last half of the seventeenth century there were developments that "put hydrology for the first time

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[11] O. E. Meinzer, "History and Development of Ground-Water Hydrology," Journal Washington Academy of Science, 24:7, January, 1934.

on a quantitative basis."[12] The French physicist Pierre Perrault (1608 - 1680) made rainfall measurements for three years on the Seine River drainage basin above Burgandy. From estimates of the drainage basin area and rainfall runoff, he concluded that the quantity of water was about six times the amount discharged by the river, thus establishing the existence of enough rainfall to supply the discharge of springs and streams.

Through a series of developments in ground water hydrology since Perrault's time, the evaporation-condensation-precipitation cycle is almost universally accepted.

Predictions of Amount of Ground Water

The total amount of ground water beneath the surface is difficult to estimate. Any attempt at an estimation must be based on the knowledge of two factors; the average porosity of the rocks in the zone of fracture, and the extent of the thickness of the zone. Both items vary widely in different geographic locations. Naturally, there must be a source of water supply. This source is precipitation in the form of rainfall or snow. Once the water supply reaches the surface, the soil acts as a separating surface and divides the rainfall into two parts.

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[12]Meinzer, op. cit., p. 11.

The first part, "surface run-off," does not soak into the ground, but flows overland into a stream, and is absorbed by the soil. There it may be evaporated by the sun, transpired by plants, or it may seep slowly to the water table.

The infiltration portion of the water supply is of most concern to this study, and is of utmost importance in ground water hydrology. This is the sole source of the ground water supply for wells, springs, and streams.

The amount of water that is infiltrated into the soil depends on such factors as slope, type of soil, type of vegetation, the amount and intensity of rainfall, and the presence of surface streams and irrigation ditches. As for the effect of slope, for a given amount of rainfall over a given period of time, the greater the slope the less the infiltration. By terracing farm land, water is forced to take a near level route, decreasing its velocity and increasing the infiltration rate. The presence of vegetation creates a more absorbent area and causes less run-off and higher infiltration. The porosity, or the ratio of volume of void space to the volume of the soil determines how much water can be stored in the soil. The part that streams and irrigation ditches play in the recharge of ground water is an important one in the plains area. As determined from topographic maps of the area, at

least thirty irrigation ditches emanate from Boulder, South Boulder and Coal Creeks. During the growing season these ditches are utilized, and at the same time wells are pumped to augment the irrigation ditch rights. This pumping lowers the ground water table and allows more water to infiltrate from the irrigation ditches and streams into the ground.

The permeability, or capacity to transmit water under pressure through a soil, determines how fast the water can be transmitted downward. The effect of rainfall is obvious, and the effects of the intensity of rainfall can be seen by observing a slow drizzle, which will produce less run-off and more infiltration than would a cloudburst, with total rainfall being the same in both instances.

Occurrence and Distribution of Subsurface Water

Subsurface or underground water is used here to include all water occurring in liquid form below the ground surface. Subsurface water may be divided into two great zones, separated by the water table. The water table is defined as the contact plane between free ground water and the capillary fringe, and is located by the level at which water stands in boreholes tapping free water, or by the water levels in water table

wells.[13] The upper zone is the unsaturated zone, sometimes known as the zone of aeration, the vadose water zone, or the zone of suspended water. The lower zone is the saturated zone, sometimes referred to as the phreatic zone. The lower zone also contains any confined water that may exist. Figure 2 illustrates the various zones.[14]

The Unsaturated Zone

Water in the unsaturated zone includes both stored and moving water. The stored water occurs as attached films on the surfaces of particles. The stored water occurring above the capillary fringe is called "pellicular water."[15]

When it rains after a dry period, the water moves into the soil and the pellicular water requirements must first be satisfied before any excess water can move downward. Water in the unsaturated zone that moves downward is known as "gravity water."

Sometimes there exists in the zone of aeration an impervious stratum below pervious deposits that will

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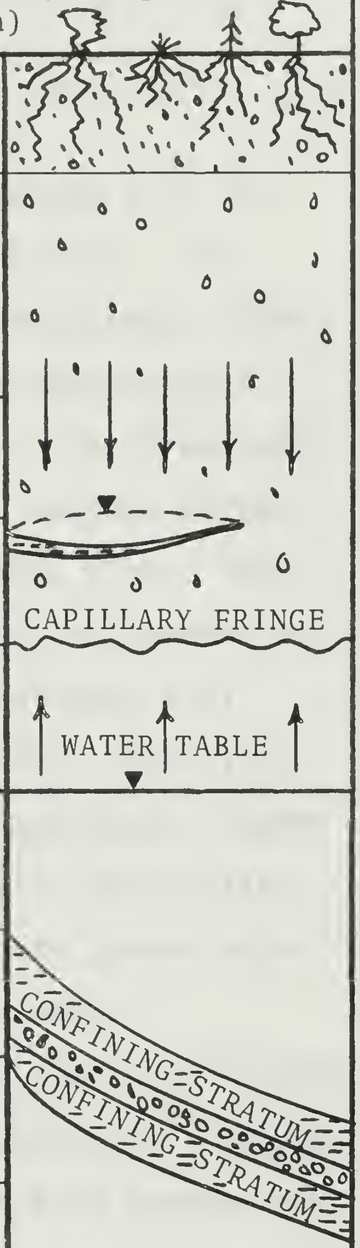
[13] C. F. Tolman, Ground Water (New York: McGraw-Hill Book Company, Inc., 1937), p. 38.

[14] Ibid., pp. 39-40.

[15] Ibid., p. 40.

FIG. 2 - OCCURRENCE AND DISTRIBUTION OF SUBSURFACE WATER (From C. F. Tolman)

UNSATURATED ZONE (ZONE OF AERATION)	SUSPENDED WATER	SOIL WATER	Limited to the soil and reached by roots
		PELLICULAR WATER	Adheres to rock surfaces throughout zone of aeration and is not moved by gravity but may be abstracted by evaporation and transpiration
		GRAVITY OR VADOSE WATER	Moves downward by force of gravity throughout the zone
		PERCHED WATER	Occurs locally in the zone above an impervious barrier
		CAPILLARY WATER	Occurs only in the capillary fringe at bottom of the zone
SATURATED ZONE	GROUND WATER (PHREATIC WATER)	FREE WATER	Occurs below the water table and is bounded by the first effective confining stratum
		CONFINED WATER	Occurs beneath a confining stratum
		FIXED GROUND WATER	Occurs in subcapillary openings, not moved by gravity
		CONNATE WATER	Water entrapped in the rocks at the time of their formation
ZONE OF DISCONNECTED OPENINGS		INTERNAL WATER	



support a body of water that is known as a "perched water table."[16]

The Saturated Zone

The zone containing free water extends from the water table level to the first impervious layer. The vertical location of the water varies considerably, from just below the ground surface to several hundred feet below the ground surface in arid regions. The free water acts as a single water body, much like a surface stream, and moves by converting potential head into flow. The free ground water table generally follows the contour of the land surface, and a plot of the water table will indicate direction of flow of a water table. The flow will be at right angles to the contours and from a higher elevation to a lower elevation. When wells are drilled into free water, the water will rise to the ground water level. Figure 3 illustrates free ground water.

Also located within the saturated zone is confined water. This water moves in strata, conduits, or arteries under the influence of the difference in head between the intake and discharge area of the first impervious stratum, and may be made up of one or more such confined areas. The movement of such water is usually independent of the surface topography and is controlled by large scale

[16] Ibid., p. 42.

FIG. 3 - GROUND-WATER TABLE IN LOOSE, UNCONSOLIDATED MATERIAL. WELLS NOT PUMPING

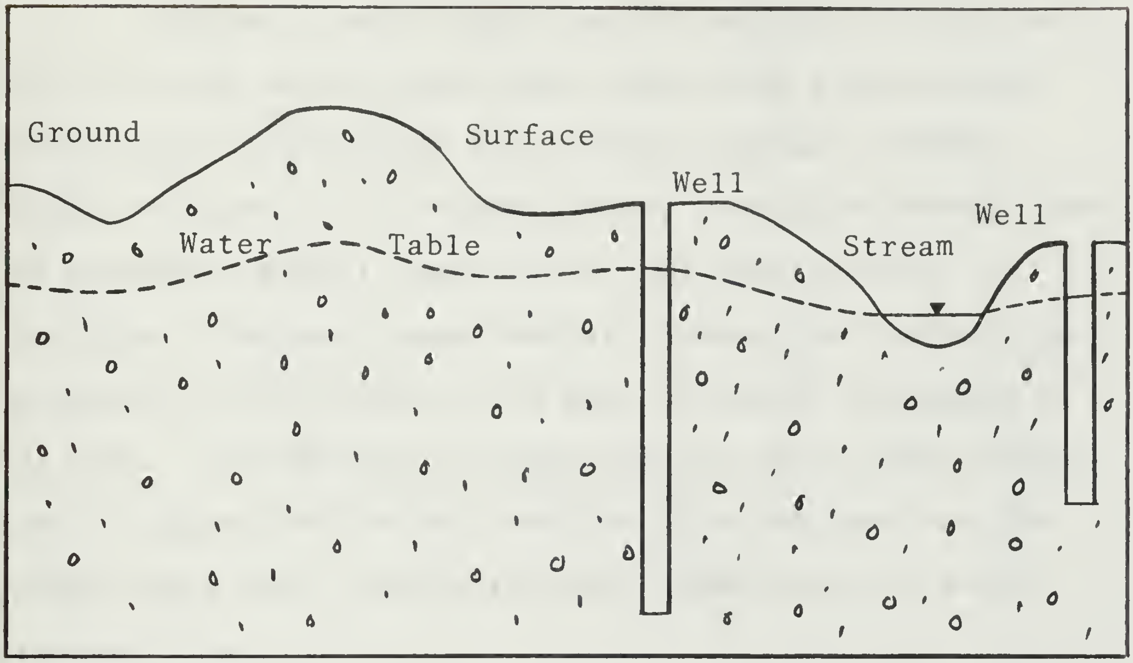
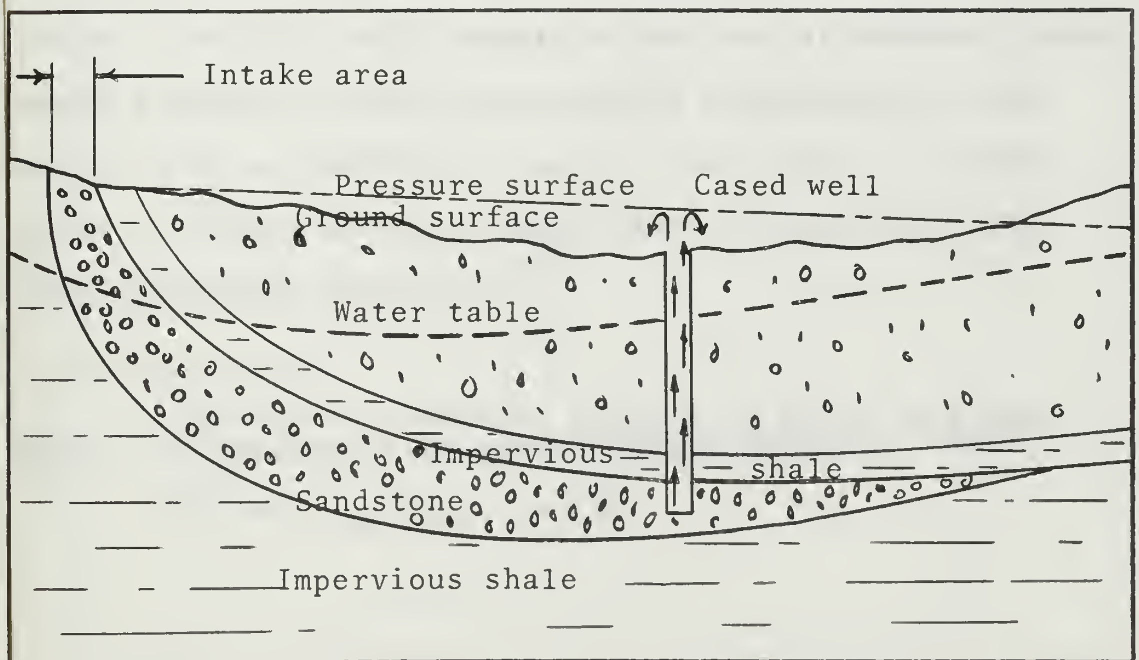


FIG. 4 - AN ARTESIAN WELL WITH AQUIFER EXPOSED AT THE SURFACE AND BEING PINCHED OUT AT DEPTH



geographic and geologic conditions.[17] Figure 4 illustrates confined ground water.

Figures 5 and 6 show that the majority of the wells in the study derive their water from free ground water. These wells are shallow and are near surface streams and/or ditches. The streams in the area flow through beds of boulders, gravel, sand, silt, and clay, called alluvium. Because these beds are stream fed they are good producers of free water, and have a typical thickness of 25 feet. In addition to these shallow wells, many deeper wells obtain their water from the alluvium, and use the added depth into the Pierre shale formation as a water storage area.

Both fixed ground water and connate ground water are also located in the saturated zone. Fixed ground water is held in small openings that resist movement under usual hydraulic conditions existing underground. This water is of no beneficial use to a well owner. Connate water is saline water entrapped when sedimentary rocks were originally deposited.[18]

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[17] Theodore R. Walker, Lecture to Class in Ground Water, University of Colorado, Spring Semester, 1966.

[18] Tolman, op. cit., p. 43.

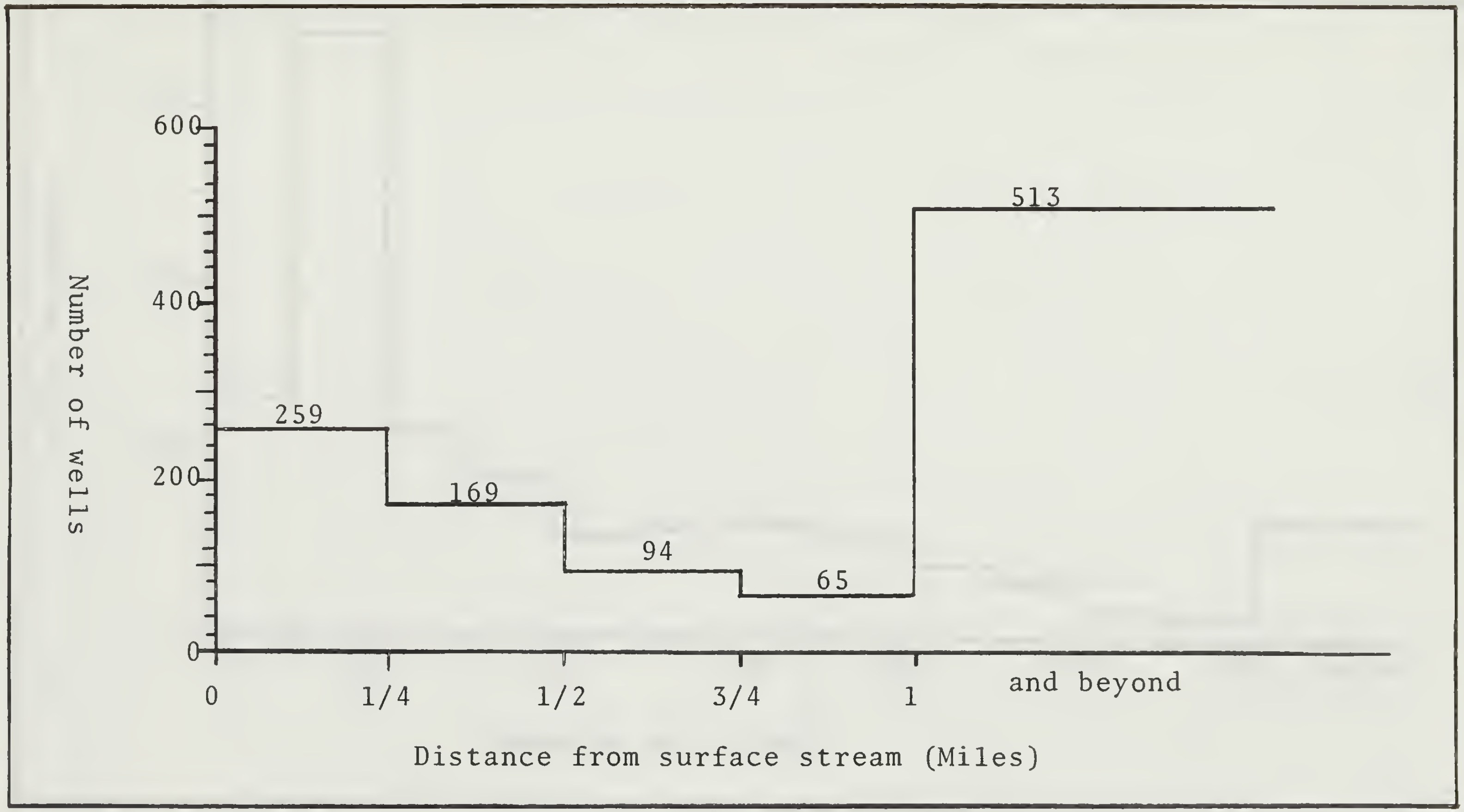

FIG. 5 - DISTANCE FROM SURFACE STREAM VERSUS FREQUENCY OF OCCURRENCE OF ALL REGISTERED WELLS IN THE DISTRICT

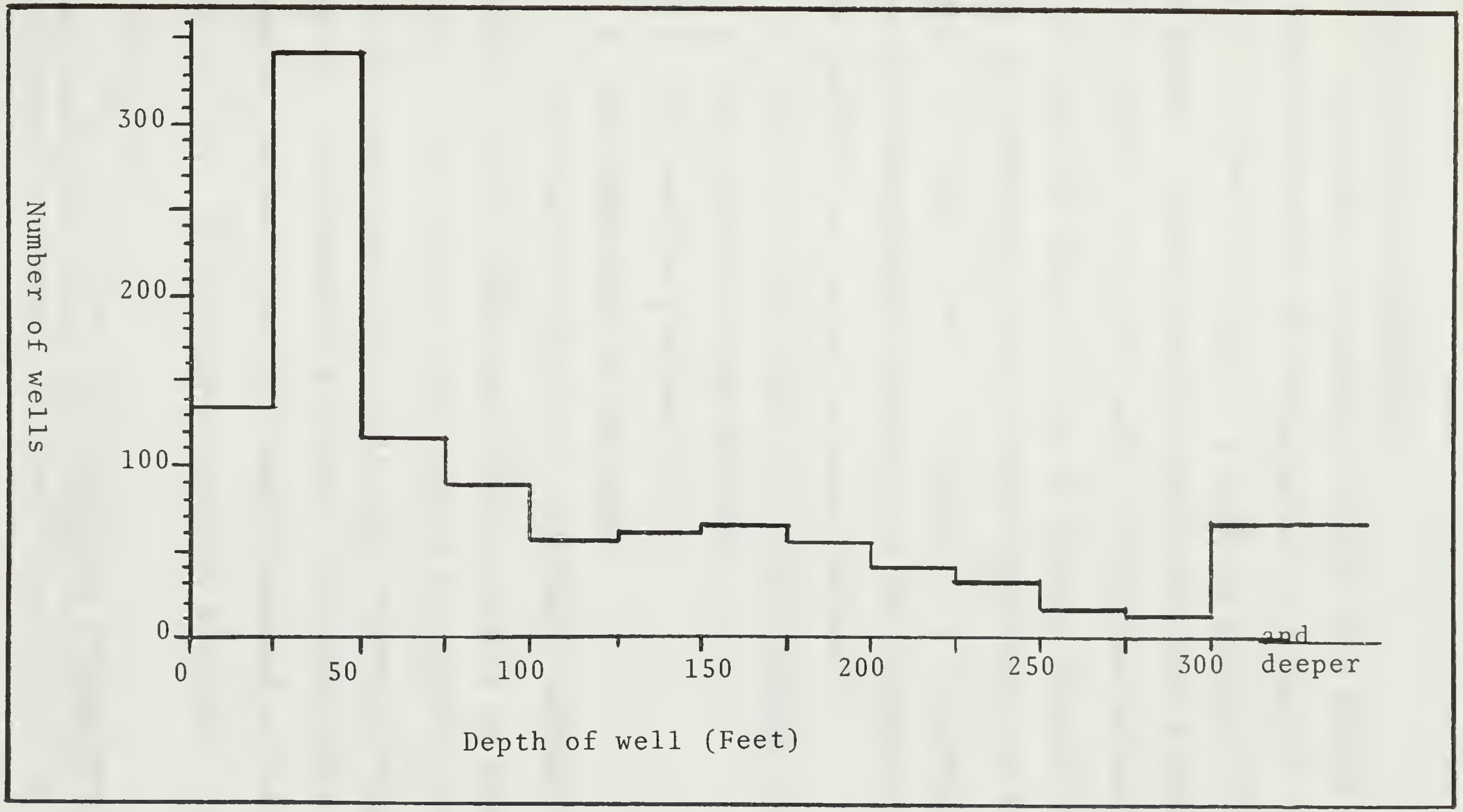

FIG. 6 - DEPTH OF WELL VERSUS FREQUENCY OF OCCURRENCE OF ALL REGISTERED WELLS IN THE DISTRICT

Motions of Water Underground

The reason for motion of water in a porous medium is exactly the same as for movement in a pipe or conduit; because of the existence of a pressure gradient between two points. In the case of ground water the pressure is due to gravity acting on water at different elevations. It is seen that there is also an analogy between stream flow and underground flow in that both flows are from a higher to a lower level. The hydraulics of underground flow vary considerably depending on the following elements that control flow through a porous medium.[19]

1. The size of the pores in a water bearing formation.
2. The porosity of the material.
3. The pressure gradient "i".
4. The temperature of the water.

The effects of pore size obviously indicate a greater flow for larger pore sizes, such as in sand or gravel. Flow would be much greater for higher porosities than for lower porosities, all other elements being constant. The pressure gradient "i" is the change in pressure, or head, per unit length measured in the direction of flow. With a higher pressure gradient, a higher

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[19] C. S. Slicter, The Motions of Underground Water, U. S. Geological Survey Water Supply Survey Paper 67, (Washington: Government Printing Office, 1902), p. 18.

flow will result. Temperature affects the viscosity of the water; a higher temperature produces a greater rate of flow than a lower temperature.

Different materials exhibit different permeability and porosity characteristics, and these variable factors are combined into a factor designated "k", called the coefficient of permeability. With "k" known, Darcy's law will hold for flow through an underground route.

The law is

$$v = ki$$

where

v = velocity of flow through the material

k = the coefficient of permeability

i = the hydraulic gradient.

From water supply paper 596-F (pages 164-169) flow rates for unconsolidated material under a hydraulic gradient of 1% are as shown in Table 1.

TABLE NO. 1

AVERAGE VELOCITIES IN UNCONSOLIDATED MATERIALS FOR ONE PER CENT HYDRAULIC GRADIENT

Type of Material	Average velocity, feet per day
Black gumbo to clay	0 to 0.001
Silt, fine sand, loess	0.042
Sand, sandstone to medium sand	1.03
Medium to coarse sand, sandy gravel	6.33
Gravel	25.0
Coarse gravel	110.0

As indicated in Table 1, ground water may move very slowly. Slicter compares this motion of ground water to ". . . the slow motion of very viscous syrup or the slowly creeping ice of a glacier."[20]

Having established factors controlling velocity of underground water by use of Darcy's law, and applying the Equation of Continuity; $Q = kiA$

where: Q is the quantity of flow

A is the cross-sectional area of openings

the quantity of flow in a water bearing stratum can be determined.

From the continuity equation it can be seen that the quantity of water flowing or percolating through a given formation is directly proportional to the cross-sectional area, the hydraulic gradient, and the permeability of the material.

Formation of a Cone of Depression and Pressure Relief

When a well is placed in a free water zone, a "cone of depression" is formed as water is pumped from the well. When a well is placed in a confined water zone, a "cone of pressure relief" is formed as water is removed from the well.

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[20] *Ibid.*, p. 35.

Figures 7 and 8 illustrate a cone of depression and a cone of pressure relief, respectively.

Both types of cone display a similar shape, but normally the cone of pressure relief is flatter and covers a larger area. The effects of pumping a water table well are seldom noticed beyond several hundred feet, whereas the effect of pumping a confined water well may be felt as a loss of pressure several miles away from the pumped well.[21]

As water is pumped from a well, flow lines are altered and tend to turn inward towards the well, or the area of low pressure. If water is not pumped from the ground it will continue to flow in its slow viscous manner to one of many outlets. The water table may intersect the ground surface and form springs, be interrupted by a natural stream or drainage net and add water to the stream, or move on its course to the sea as a vast sheet of ground water or "underflow."[22]

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[21]Walker, op. cit.

[22]Slicter, op. cit., p. 35.

FIG. 7 - CONE OF DEPRESSION FORMED BY PUMPING
A WATER TABLE WELL

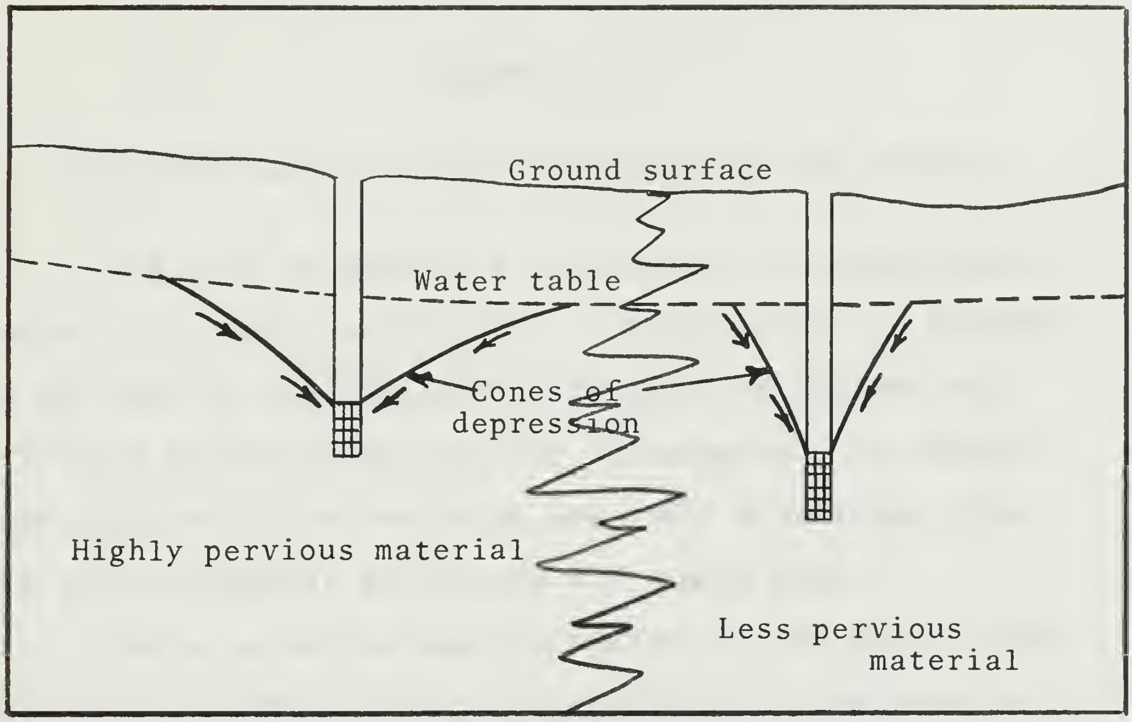
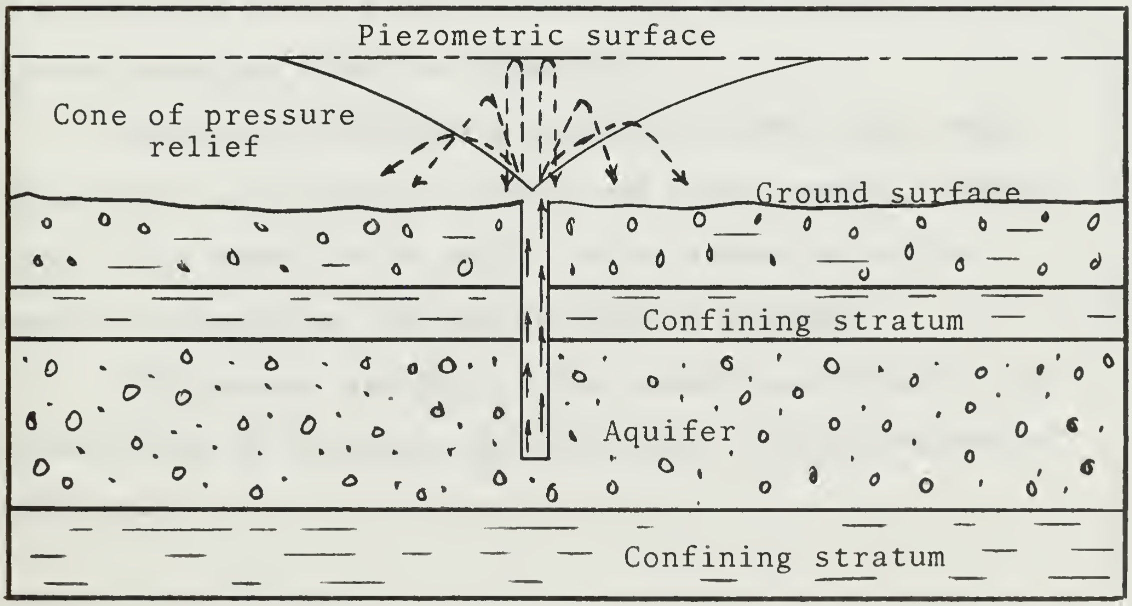


FIG. 8 - CONE OF PRESSURE RELIEF DUE TO A FLOWING
ARTESIAN WELL



CHAPTER IV

GEOGRAPHIC AND GEOLOGIC DESCRIPTION OF THE DISTRICT

The city of Boulder is located in the approximate center of Irrigation District 6. The District is bounded on the west by the Continental Divide, and extends eastward five miles beyond the city of Longmont. It extends some eight miles in the north and south directions from the city of Boulder and covers 512 square miles.

The area to the west of Boulder is the mountainous watershed for the streams in the District. The area to the east of Boulder is part of the Continental slope that extends to the Mississippi Valley. It consists primarily of a terraced flood plain, covered by the outwash of the streams emerging from the mountains.

Since an overwhelming majority of the 1100 registered wells is located in the flood plain region, rather than in the mountainous region, more emphasis in the report is placed on the region east of Boulder.

The general geology of the mountainous region can be described as weathered granite with varying degrees of soil cover.

The general geology of the plains area can best be described in Table 2 and Figure 9.

TABLE NO. 2

FORMATION	MEMBER	TYPICAL THICKNESS FEET	PHYSICAL CHARACTER	WATER SUPPLY
Alluvium (Qal)		25	Boulders, gravel, sand, silt, and clay	Yields moderate quantities of water to wells, springs, seeps.
Eolian silt and sand (Qes)		10	Poorly sorted sand and silt; contains some pebbles	Generally lies above water table. In some areas yields small quantities of water to wells.
Undifferentiated upland deposits (Qre)		25	Boulders, gravel, sand, and clay	Generally yields small quantities of water to wells, springs, and seeps. Yields moderate quantities from sorted gravel in a few places
Terrace gravel (Qtr)		10	Cobble and pebble gravel; contains sand and silt.	Generally lies above water table. In some areas yields small quantities of water to wells where saturated.

TABLE NO. 2 - Continued

FORMATION	MEMBER	TYPICAL THICKNESS FEET	PHYSICAL CHARACTER	WATER SUPPLY
Arapahoe formation (Ka)		200	Arkosic sand, gravel, and conglomerate interbedded with clay and shale; contains large ironstone concretions.	Yields moderate quantities of water to wells. Water of fair to good quality for most uses but dissolved solids concentration varies considerably.
Laramie formation (Kl)		400	Blue-gray silty shale; contains several silty sandstone beds and lignite seams. Coal beds scattered throughout.	Yields little or no water to wells in area. Water is of poor quality. Contains hydrogen, sulfide, iron and methane.
Fox Hills sandstone (Kfh)	"B"	80	"Salt and pepper" sandstone uniformly medium grained, fairly hard, massive.	Yields moderate quantities of water to wells. Water of good quality except in local geologic structure, where it may have undesirable amounts of iron, or hardness.
Fox Hills sandstone (Kfh)	"A"	130	Similar to "B" sandstone above, but has slightly yellow tint. Frequently thin sands interbedded with siltstone and shale, but in places massive.	Moderate yields of good quality water to wells.

TABLE NO. 2 - Continued

FORMATION	MEMBER	TYPICAL THICKNESS FEET	PHYSICAL CHARACTER	WATER SUPPLY
Fox Hills sandstone (Kfh)	Milliken	100	Extensive fossiliferous quartz sandstone containing biotite and muscovite. Characteristic yellow color caused by iron oxide.	Moderate yields of good quality water to wells.
Fox Hills sandstone (Kfh)	Transition zone	900	Interbedded sand and shale; becomes more shaly near bottom.	Poor, not developed as an aquifer. Yields small amounts of poor quality water to wells.
Pierre shale (Kp)		7500±	Dark-gray to black marine shale, and silty sandstone containing thin limestone lenses. Hygiene sandstone member; Dark greenish-gray and gritty sandstone; about 500 feet thick; lies about 1,500 feet above the base of the Pierre.	Poor, yields small quantities of water in weathered zone to wells.

TABLE NO. 2 - Continued

FORMATION	MEMBER	TYPICAL THICKNESS FEET	PHYSICAL CHARACTER	WATER SUPPLY
Niobrara formation (Kn)		300±	Black to gray calcareous marine shale, gray to greenish white limestone and white chalky marl.	Poor, yields small quantities of water in weathered zone to wells.
Benton shale (Kb)		500	Blue-gray and dark-brown fossile marine shale, persistent bentonite seams, chalky limestone, and thin sandstone near top.	Poor, yields small quantities of water in weathered zone to wells.
Dakota sandstone (Kd)		300	Fine- to medium-grained, friable to firm gray-white sandstone; thin-bedded to massive; contains some shale in the upper part. Dark-gray, silty, carbonaceous shale in the middle part. Coarse-grained gray sandstone; locally conglomeratic in the lower part.	Poor to moderate quantities of water to wells near outcrop.
Morrison formation (Jm)		300	Varicolored claystone, limestone, mudstone, sandstone, and siltstone.	Unknown

TABLE NO. 2 - Continued

FORMATION	MEMBER	TYPICAL THICKNESS FEET	PHYSICAL CHARACTER	WATER SUPPLY
Ralston Creek formation (Jrc)		40	Calcareous sandstone and siltstone in various shades of red and gray.	Unknown
Entrada sandstone (Je)		30	Fine- to medium-grained well-sorted white sandstone.	Unknown
Lykins formation (Tr Pl)		550	Interbedded soft sandstone and sandy shales containing some limestone.	Unknown
Lyons sandstone (Pl)		250	Firmly cemented crossbedded quartz sandstone.	Moderate yields of water to wells and springs near outcrop.
Fountain formation (PPf)		1,000±	Crossbedded very arkosic conglomeratic sandstone; contains numerous mudstone and siltstone layers.	Fair, small yields to wells and springs near outcrop.
Crystalline rocks (pe)			Igneous rocks and metamorphosed sediments.	Fair, small yields to wells and springs from fractured and weathered zones.

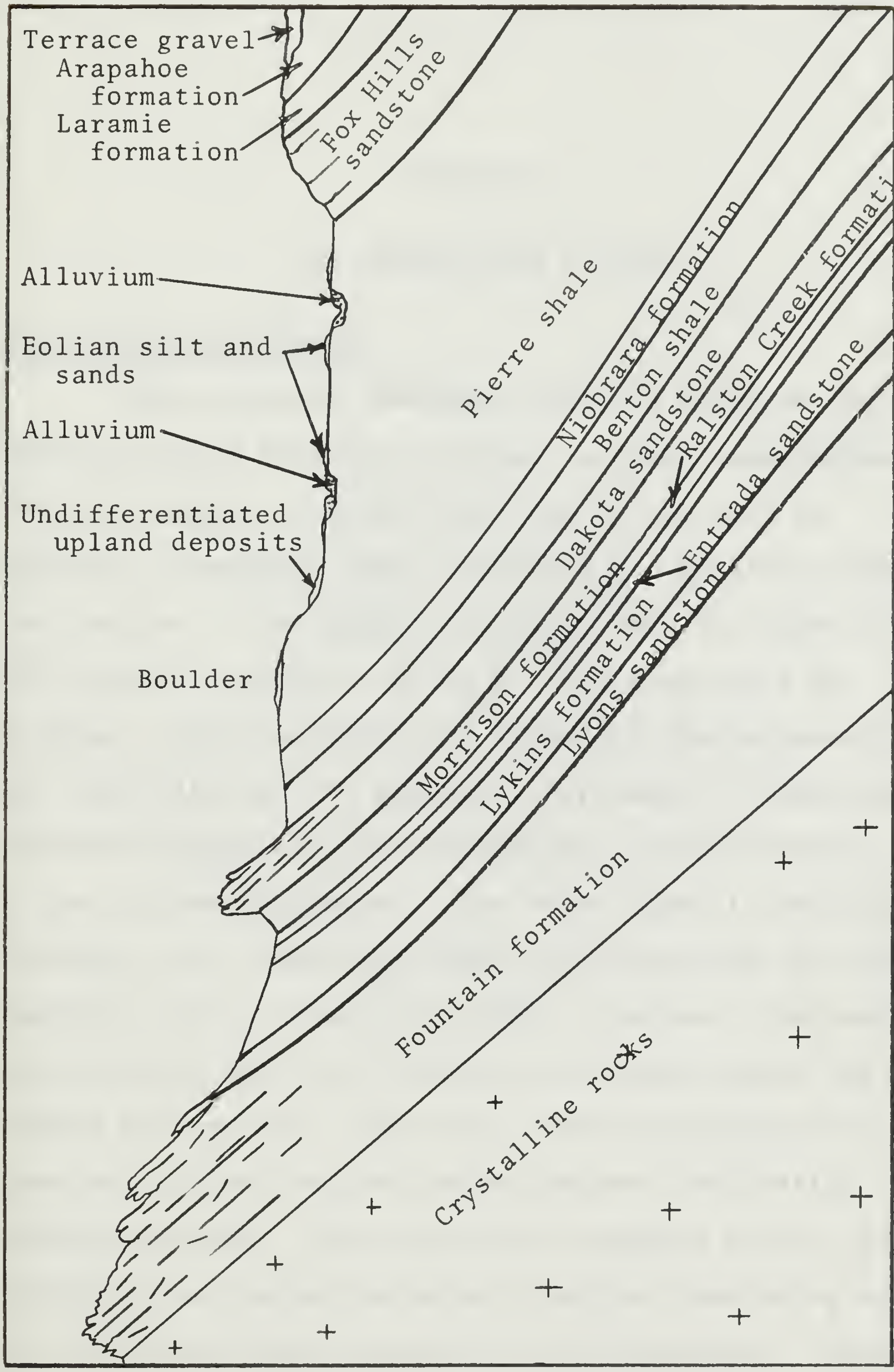


FIG. 9 - GEOLOGIC SECTION ACROSS BOULDER VALLEY

CHAPTER V

THE COMPILATION OF DATA

Well Numbering System

The system of numbering wells is based on the U.S. Bureau of Land Management systems of land subdivision. The well number shows the location of the well by quadrant, township, range, section, and position within the section. This method is illustrated by Figure 10. The capital letters A, B, C, D, locate the well by quadrant. The quadrants are formed by the intersection of the base line and the principal meridian. A indicates the northeast quadrant, B the northwest, C the southwest, and D the southeast quadrant. The first numeral indicates the township, the second indicates the range, and the third indicates the section of the well location. The lower case letters following the section number locate the well within the section. The first letter designates the quarter-section, and the second denotes the quarter-quarter section. The letters are assigned within the section in a counterclockwise direction, beginning with (a) in the northeast quadrant of each section. Letters

[illegible]

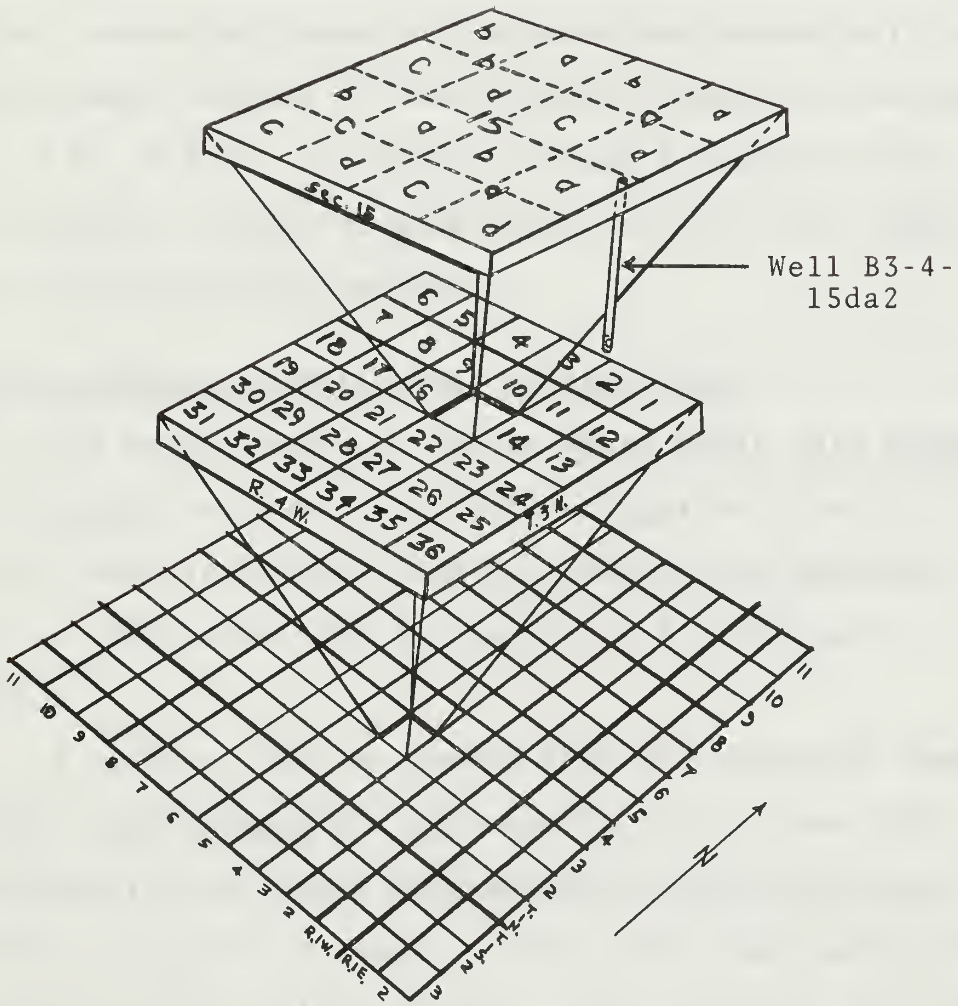
[illegible]

[illegible]

[illegible]

[illegible]

FIG. 10 - SYSTEM OF NUMBERING WELLS IN REPORT



are assigned within each quarter-section in the same manner. Where two or more wells exist in the smallest subdivision, consecutive numbers beginning with 2 are added to the letters. For example, B3-4-15da2 would indicate the well shown in Figure 10, as being the second well in the northeast quarter of the southeast quarter of section 15, T.3 N., R.4 W. The capital letter B indicates that the township is north of base line, and that the range is west of the principal meridian.

Post Card Survey of Wells Used in the Study

All wells listed in Ground Water Basic-Data Release No. 17, 1964 that were located in Irrigation District 6, were set down in tabular form as shown in the appendix. A total of 1100 wells with a capacity of 44,298 gpm is listed.

A mailing list was formed from the addresses shown in Basic-Data Release No. 17, and 899 letters and 1100 questionnaire post cards were mailed to these addresses on December 17, 1965. A sample of the letter and post card are shown on the following page. From the first mailing of 899 letters, 335 were returned as undeliverable due to insufficient address, moved with no forwarding address, and for various other reasons. Of the 335 returned letters, and an unknown number of post cards, 96 letters were remailed January 20, 1966 after consulting the

770 32nd Street
Boulder, Colorado
December 10, 1965

Dear Well Owner,

Your cooperation in filling out and returning the enclosed self-addressed questionnaire card will help in the collection of data needed for a thesis that I am preparing for an advanced degree in Civil Engineering at the University of Colorado.

Every well is important, and accuracy in filling out the questionnaire and promptness in returning it will be greatly appreciated.

Sincerely,

WELL LOCATION C1-70-12aa4

WHAT IS THE ACTUAL NUMBER OF GALLONS PER DAY ________
USED FROM THE WELL? (MEASURED, ESTIMATED?) GAL/DAY

IF MEASURED, HOW? ________________________________

USE OF WATER (CHECK ONE OR MORE). HOUSEHOLD (____)
IRRIGATION (____), OTHER (____) ____________________
(SPECIFY)

DEPTH TO WATER TABLE? ______
(FT)

Greater Metro Denver Telephone Directory. From the post card questionnaire, 291 were returned representing 26.5 per cent of the cards mailed, or 33.8 per cent of the 861 post cards that were assumed to have been delivered. Of the replies, 214 stated the amount of water used. A detailed breakdown by township of the results is shown on Table 3.

Table 3 shows a total capacity for all registered wells of 44,298 gallons per minute. The capacity listed of the 214 wells that reported the amount of water used is only 7,513 gallons per minute. The ratio of 7,513 to 44,298 is 0.170, and the ratio of 214 to 861 is 0.248. This indicates that the small capacity wells reported usage in a larger proportion than did large capacity wells. Also, comparing the columns listing average capacity of registered wells and average capacity of wells reporting a capacity illustrates the same relationship.

It can be seen that the distribution of the post card returns is spread very evenly throughout the townships with the extreme of no well reporting for the three registered wells in township B1-68, to a high of three of the four registered wells reporting in township C2-73.

Personal Interviews

Aerial photographs of the area east of the city of Boulder were examined prior to the selection of the sites

TABLE NO. 3

SUMMARY OF RESULTS OF POST CARD SURVEY

Town-ship	Number of registered wells in township	Capacity listed (gpm)	Average capacity listed (gpm)	Number of wells report-ing	Number of wells report-ing amount used	Capacity listed of wells report-ing a capacity (gpm)	Average capacity listed of wells reporting a capaci-ty (gpm)	Amount report-ed used (gpm)
B1-68	3	827	276	0	0			
B1-69	73	2,307	32	35	33	738	22	22
B1-70	375	14,735	40	103	72	1,228	17	126
B1-71	110	990	9	35	27	279	10	20
B1-72	9	78	9	3	2	2	1	1
B1-73	0			0	0			
B1-74	0			0	0			
B2-68	3	1,369	456	1	1	1,350	1,350	889
B2-69	1	15	15	1	1	15	15	1
C1-68	0			0	0			
C1-69	73	8,485	116	16	13	3,243	249	10
C1-70	247	6,135	25	45	29	435	15	24
C1-71	46	8,674	189	13	11	18	2	12
C1-72	36	168	5	11	7	130	19	1
C1-73	15	108	7	3	2	35	18	1
C1-74	0			0	0			
C2-69	0			0	0			
C2-70	0			0	0			

[illegible]

TABLE NO. 3 - Continued

Township	Number of registered wells in township	Capacity listed (gpm)	Average capacity listed (gpm)	Number of wells reporting	Number of wells reporting amount used	Capacity listed of wells reporting a capacity (gpm)	Average capacity listed of wells reporting a capacity (gpm)	Amount reported used (gpm)
C2-71	57	116	2	16	9	12	1	25
C2-72	48	271	6	6	5	16	3	1
C2-73	4	20	5	3	2	12	6	1
C2-74	0			0	0			
Totals	1100	44,298		291	214	7,513		1,134

[illegible]

to be visited. The coverage area of three sets of photographs dated July 23, 1937, September 17, 1949, and October 5, 1964, were plotted on a map. An area of overlap occurred in sections 33 and 34 of T. 1 N., R. 70 W. These two sections are bounded on the south by Base Line Road, and are between Base Line Reservoir and the city of Boulder. Empson Ditch runs through both sections in an easterly direction. Bear Canyon Creek runs northward through section 33, and South Boulder Creek flows northward through section 34. A small part of Base Line Reservoir lies in the southeast portion of section 34.

Residences to be interviewed were selected from the 1964 photograph, and occupants were interviewed on April 2, 1966. A total of thirty-six houses were selected, eighteen from each section. The results of the interview are as shown in Table No. 4.

TABLE NO. 4

SUMMARY OF RESULTS OF PERSONAL INTERVIEWS

SECTION	INTERVIEWS OBTAINED	NO. WELLS OWNED	NO. WELLS REGISTERED	AVERAGE DEPTH	WATER (GPD)
B1-70-33	16	10	1	17'	unknown, summer irrigation only
B1-70-24	31	20	3	21'	7,250 (Total)
TOTAL	29	30	4	19'	unknown

The residences in section 33 derived their domestic water from the Wagoner Water District, and used their wells for lawn irrigation only. Every person interviewed who did not have an irrigation well said that they were planning to obtain one because the Wagoner water rates were too high to use the water for irrigation.

The wells in section 34 supplied both domestic and irrigation water. Most people reported that they owned two wells; a very shallow one, usually less than 10 feet deep, for irrigation, and a deeper well for domestic use. Several people with lots adjacent to South Boulder Creek did not bother with an irrigation well - they pumped water directly from the creek during the summer for lawn irrigation.

CHAPTER VI

GENERAL CONCLUSIONS

Creditability of the Data

The bookkeeping involved in compiling the data from only 1100 wells was tedious, and required the copying of data from many different sources. Therefore, there is the possibility for errors. It is no surprise then, because of the larger number of wells, that there were discrepancies between the various sources of data provided by the State. For example, the primary source of data that the appendix is based upon, Colorado Ground Water Basic-Data Release No. 17, 1964, listed 1100 wells in the District, while Colorado Ground Water Basic Report No. 5, 1961, listed 283 wells in the District. Of the latter report, only 82 of these wells were also listed in Basic-Data Release No. 17. Since this fact was not discovered until after most of the post card questionnaires were returned, it was decided not to include the additional 201 wells in the appendix. In addition, there were 144 city well permits filed in Boulder's Building Inspector's Office that were not included in the appendix. It could not be

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

determined from the information available if any of the city well permits were issued for wells registered with the State. These records indicate that there exist at least 1445 wells in the District.

Another discrepancy that existed between the two reports was in the location of wells within sections. Of the 82 wells appearing in both publications, approximately 20 were not in agreement as to which quarter-quarter section they were located. The fact that they were the same well was established by comparisons of well owners, dates of completion, and depths of the wells as listed in the two publications. The placing of wells on Plate No. 1 was determined from well locations in _Basic-Data Release No. 17_.

Another case of apparent discrepancy is typified by irrigation well B1-70-19ca2. This well shows a depth of only 13 feet, but the water table is located at 20 feet. Either an obvious typographical error has been made or the well is a poor producer.

Furthermore, some of the data reported on the post card survey are obviously in error. For example, wells in the B1-69-1bc quarter-quarter show a depth of around 240 feet, while the reported depth to water is listed at 265 feet.

The preceding examples show that this study is not an exact and absolute description of ground water

appropriations in the district, but is, however, a general indication of what is occurring in the way of ground water appropriations.

Probable Number of Wells and Water Usage, Present and Future

The present number of wells in the District is in excess of the 1100 registered wells, with records available indicating at least 1445 wells. From observations obtained from viewing aerial photographs, personal interviews, and automobile trips through the District, it is the author's estimate that there are three times this number, or approximately 4000 wells.

Table No. 3, the summary of results of the post card survey, shows that for the wells reporting a capacity, their total listed capacity was 7,513 gpm. The amount of water used from these wells was 1,133 gpm, or only about 15 per cent usage of listed capacity. Applying the 15 per cent to the listed capacity of 1100 wells or 44,298 gpm, yields a probable usage of 6,600 gpm for 1100 wells, or 6 gpm per well. Applying 6 gpm per well yields 24,000 gpm for 4,000 wells or an equivalent flow of 53 cfs.

The summary results from the post card survey and the personal interviews, Tables No. 3 and 4, can be utilized to obtain future usage data. The prediction is based on the assumption that the data established in these

Tables is correct, and represents a true presentation of predicted future ground water development in the District.

Table No. 4, the summary of results of personal interviews, shows that there are a total of 30 wells, and that only 4 of these wells are registered. This represents only 13.3 per cent of the registration. Applying this 13.3 per cent to the 1100 registered wells, yields a possible existence of 8,250 wells. Again applying 6 gpm per well yields 49,500 gpm for 8,250 wells, or an equivalent flow of 110 cfs.

As was stated in the introduction, the area for personal interviews was representative of future well development in the District. The extent of the growth of the area can be seen by the following table. This table was prepared by counting the houses shown on the aerial photographs.

TABLE NO. 5

THE NUMBER OF HOUSES IN SECTIONS 33 AND 34 OF T.IN., R70W

YEAR	SECTION 33	SECTION 34
1937	24	20
1949	27	40
1964	131	146

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]

By recalling that the percentage of reports of low capacity wells was higher than the reportage of high capacity wells, it can be shown that the predicted water usage is too low. On the other hand, it may be stated that the area selected for personal interviews may favor a prediction of water usage that is too high. The exact effect of these two ideas is not known, but may be thought of as cancelling each other.

The Source of Water

The proximity of the wells to a surface stream is indicative of the source of water for the well. Figure 5 shows that over one-half of the wells in the study are located within one mile of a stream, and that approximately one-fourth of the wells are located within one-fourth of a mile of a stream. Figure 6 shows that almost one-half of the wells are less than fifty feet deep.

Several cross-sections in Figure 11 are shown to illustrate why so many of the wells are near a surface stream and are shallow. The cross-sections were drawn from selected well logs taken from *Basic-Data Report No. 5*. An example of well logs is shown on the following page.

The fact that these wells are free ground water wells, rather than confined water wells allows many wells to be placed in a small area. Recalling that the effects

SELECTED WELL LOGS

	Thickness	Depth
B1-70-19ca. Alt. 5,390 ft.		
Clay	3	3
Alluvium:		
Clay and gravel (water level, 8 feet)	7	10
Clay, gravel, and sand	21	31
Pierre shale (bedrock):		
Shale	6	37
B1-70-20cb2. Alt. 5,333 ft.		
Soil	1	1
Undifferentiated upland deposits:		
Clay, sandy	5	6
Clay, (water level, 6 feet)	7	13
Sand and gravel	4	17
Clay, sandy	11	28
Pierre shale (bedrock):		
Shale	3	31
B1-70-21cb2. Alt. 5,285 ft.		
Soil	1	1
Undifferentiated upland deposits:		
Sand and gravel	3	4
Clay (water level, 8 feet)	16	20
Sandstone, hard	7	27
Pierre shale (bedrock):		
Shale	49	76
B1-70-22ad. Alt. 5,175 ft.		
Alluvium:		
Sand and black dirt	4	4
Sand, silt and mica (water level, 10 feet)	22	26
Pierre shale (bedrock):		
Shale	3	29
B1-70-22dd. Alt. 5,172 ft.		
Soil	1	1
Alluvium:		
Gravel and sand (water level, 3 feet)	16	17
Pierre shale (bedrock):		
Shale	8	25

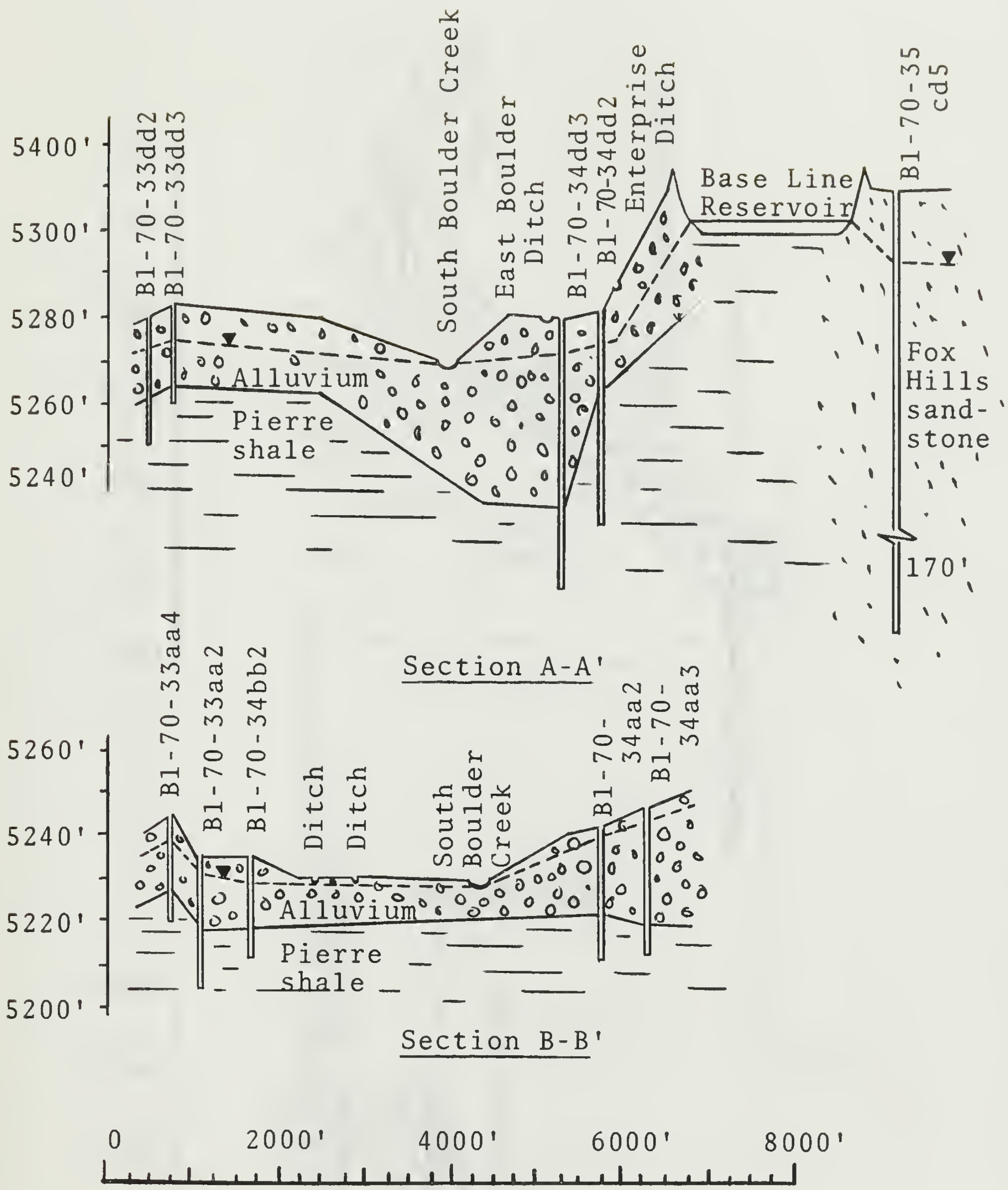
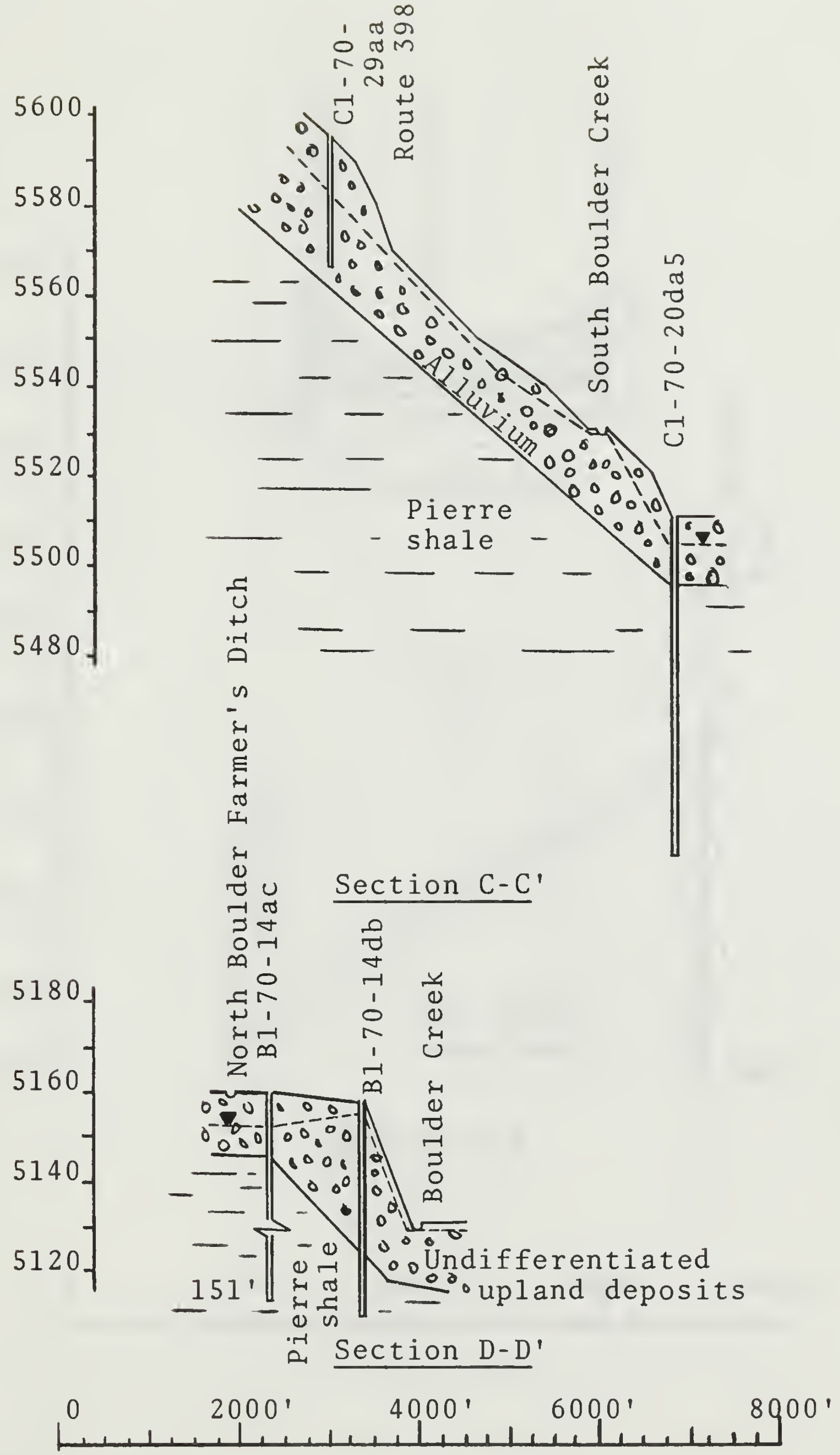
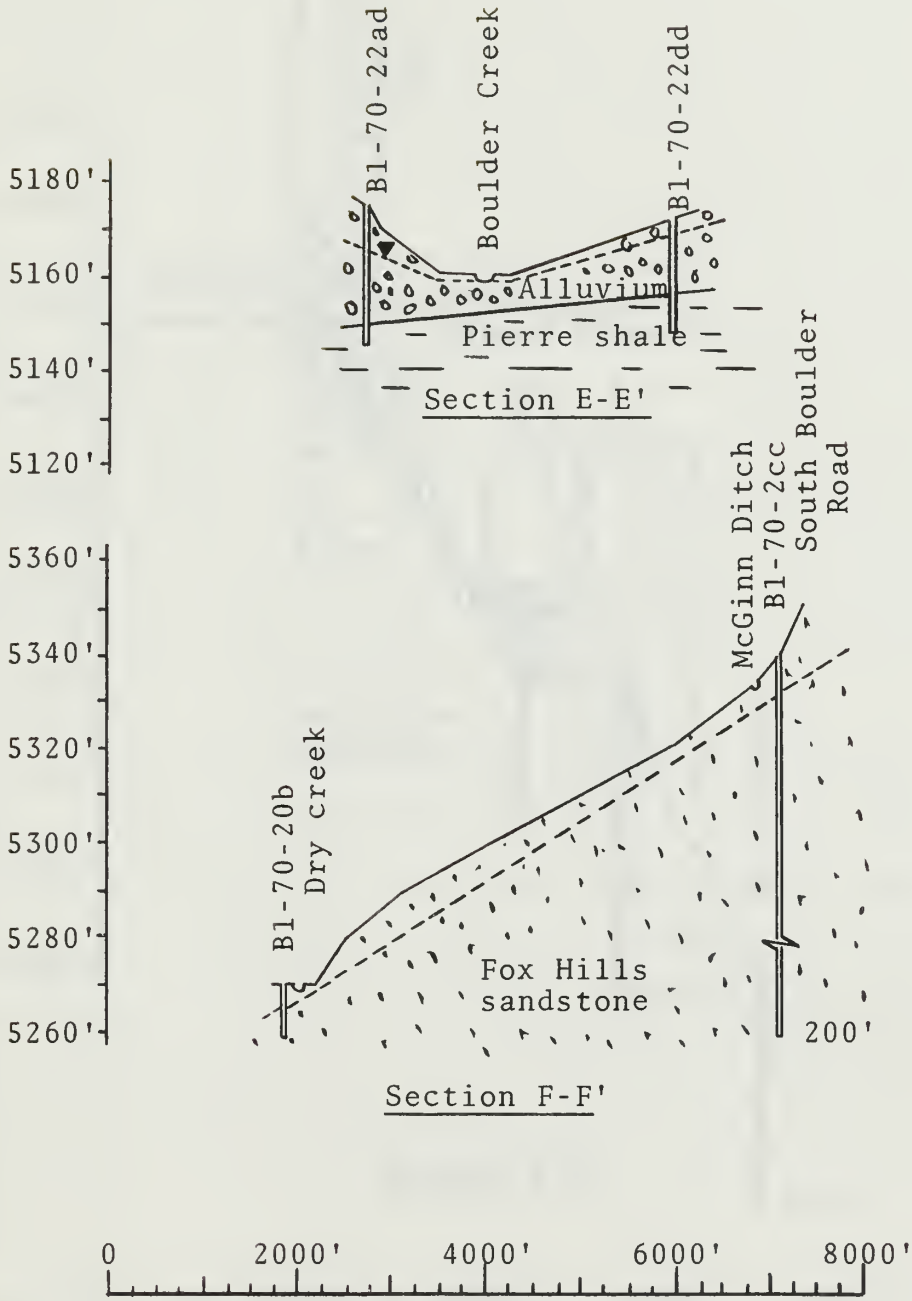
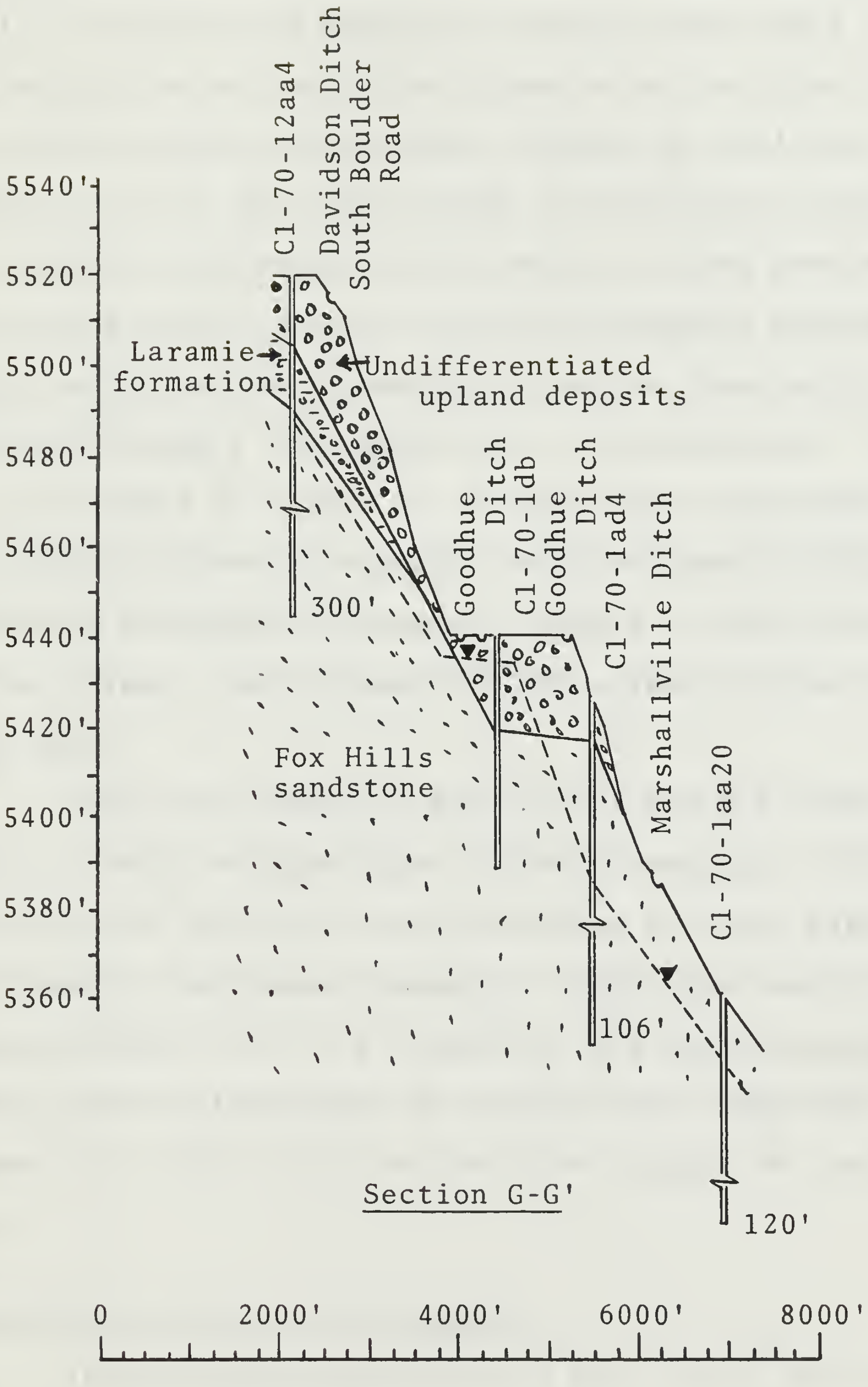


FIG. 11 - CROSS-SECTIONS OF PLAINS AREA


5600
5580
5560
5540
5520
5500
5480
C1-70-
29aa
Route 398
South Boulder Creek
C1-70-20da5
Alluvium
Pierre
shale
North Boulder Farmer's Ditch
Section C-C'
5180
5160
5140
5120
B1-70-14ac
B1-70-14db
Boulder Creek
Undifferentiated
upland deposits
151'
Pierre
shale
Section D-D'
0
2000'
4000'
6000'
8000'



B1-70-22ad
Boulder Creek
B1-70-22dd
5180'
5160'
5140'
5120'
Alluvium
Pierre shale
Section E-E'
McGinn Ditch
B1-70-2cc
South Boulder Road
5360'
5340'
5320'
5300'
5280'
5260'
B1-70-20b
Dry creek
Fox Hills sandstone
200'
Section F-F'
0
2000'
4000'
6000'
8000'


5540'
5520'
5500'
5480'
5460'
5440'
5420'
5400'
5380'
5360'
Cl-70-12aa4
Davidson Ditch
South Boulder Road
Laramie formation
Undifferentiated upland deposits
300'
Goodhue Ditch
Cl-70-1db
Goodhue Ditch
Cl-70-1ad4
Marshallville Ditch
Fox Hills sandstone
106'
Cl-70-1aa20
120'
0
2000'
4000'
6000'
8000'

Section G-G'

of pumping a free ground water well are measured in feet, while the effects of pumping a confined water well are measured in miles, each free ground water well has little noticeable effect on the other, unless two wells are spaced so close that their cones of depression intersect. The effects of permeability on wells in close proximity to each other will be greater in those materials having a high coefficient of permeability than on those wells in a material having a low coefficient of permeability. This is illustrated in Figure 7. Because most stream beds are of a highly permeable material, the influence on adjacent wells can be noticed. However, because of the proximity of the stream, the influence of the stream is also felt on each well.

Cross-sectionsA-A', B-B', C-C', and E-E' show that water is being obtained from alluvium deposits. Cross-sections D-D' and G-G' show that water is being taken from undifferentiated upland deposits. The deeper wells of cross-sections A-A', F-F', and G-G' are shown taking their water from confined water of the Fox Hills sandstone formation. These cross-sections are typical of the Plains area.

Population Growth in the District

The estimated population of the city of Boulder on 1 January 1966 was 52,588, as reported in the Statistical

Abstract, prepared and published by the Boulder Chamber of Commerce. The 1960 census show a population of 37,718. The figures for the Boulder metropolitan area are 63,000 and 44,167 respectively, for the same years. This represents rates of population increases of approximately 3000 per year for the city and approximately 3,750 per year for the metropolitan area. With this rate of growth for a small population area, it can be seen that the demands for water will be increased.

Conclusion to the Effects of Ground Water Appropriations on Surface Water Rights

The following conclusions are drawn from the study of Irrigation District 6.

1. There are presently approximately 4,000 wells pumping approximately 24,000 gpm, or an equivalent flow of 53 cfs.
2. Approximately one-half of this amount is being pumped directly from surface stream beds. This figure is based on the proximity of the wells to the streams, and to the depths of the wells. The amount of the water that is returned to the ground and surface stream is undetermined, but is estimated as between one-half and three-quarters of the amount taken.

3. Population trends indicate that a greater demand will be placed on the water resources in the future.
4. The "first in time, first in right" doctrine as upheld by the Colorado courts is being violated.
5. Many well owners are violating the law by using domestic water for irrigation purposes.

Recommendations

Due consideration should be given to the proper administration of existing laws, bearing in mind that to do so will probably result in non-use of a large portion of the underground water resource. If this is the course to be followed, it should be made known to all present and potential surface and underground water users, so that their economic planning could be based on established policies rather than chance and hope. Another feasible alternative is further legislative action that would allow both surface and underground water appropriations to be administered as a whole, rather than as separate entities.

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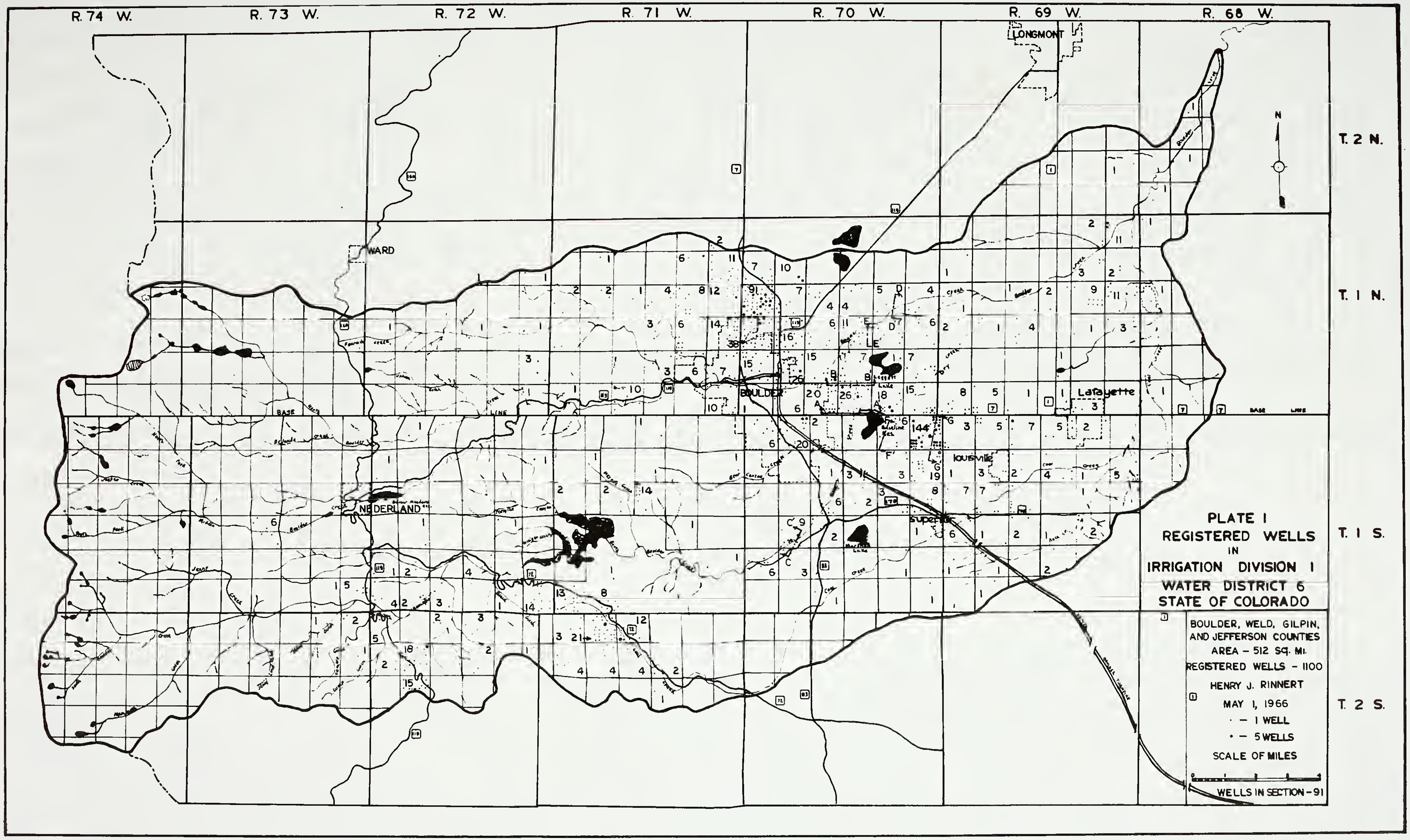
[illegible]

[illegible]


R. 74 W.
R. 73 W.
R. 72 W.
R. 71 W.
R. 70 W.
R. 69 W.
R. 68 W.
T. 2 N.
T. 1 N.
T. 1 S.
T. 2 S.
LONGMONT
WARD
BOULDER
Lafayette
Louisville
Superior
NEDERLAND
BASE LINE
N
PLATE I
REGISTERED WELLS
IN
IRRIGATION DIVISION 1
WATER DISTRICT 6
STATE OF COLORADO
BOULDER, WELD, GILPIN,
AND JEFFERSON COUNTIES
AREA – 512 SQ. MI.
REGISTERED WELLS – 1100
HENRY J. RINNERT
MAY 1, 1966
· – 1 WELL
• – 5 WELLS
SCALE OF MILES
WELLS IN SECTION – 91

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A P P E N D I X

NOTES ON APPENDIX HEADINGS

LOCATION - method of determining the location is explained on page

DEPTH TO WATER - given in feet below land surface; "FLOW" indicates that water level is above land surface.

DEPTH OF WELL - given in feet below land surface.

CAPACITY LISTED - given in gallons per minute; "DRY" indicates yield is insufficient for intended use.

PURPOSE - types of uses are noted by the following: C, commercial; D, domestic; I, irrigation; IND, industrial; M, municipal; S, stock.

POST CARD SURVEY RESULTS

WATER USED - given in gallons per day; "DRY" indicates yield is insufficient for intended use. * indicates a measured value, all others are estimated values.

DEPTH TO WATER - given in feet below ground surface.

PURPOSE REPORTED - same as PURPOSE above.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

Location	Depth to Water	Depth of Well	Capacity Listed	Purpose	Date Appropriated	Water Used	Depth to Water	Purpose Reported
B1-68								
6bb	29	35	800	I	-38			
18cb	10	53	17	D	4-27-60			
31ca	140	480	10	D	6-24-63			
B1-69								
1bc	40	230	15	D	5-8-62	400	265	D
1bc2	30	248	10	D	4-14-62	400	265	D
1bc3	40	250	15	D	4-12-62	400	265	D
1bc4	30	240	15	D	5-10-62	400	265	D
1bc5	20	240	12	D	4-30-62	400	265	D
1bc6	25	240	12	D	7-3-62	400	265	D
1bc7	60	245	15	D	11-11-62			
1bc8	30	235	12	D	7-5-62	400	265	D
1bc9	40	230	10	D	7-8-62	400	265	D
1bc10	60	330	18	D	9-4-62			
1bc11	90	265	18	D	9-6-62			
2dd	8	12	395	I	6- -54			
2dd2	10	45	8	D	7-25-61			
7aa	200	325	12	D	7-29-58			
11ad	6	25	4	D	6-13-62			
11ad2	4	45	10	D	3-17-62			
11ad3	5	10	25	-	6-15-61			
12cb	6	50	30	D	7-18-63	200	80	D
12cb2	8	50	25	D	2-6-63			
13aa	30	60	20	D	7-30-63	80	60	D
13aa2	35	50	15	D	5-16-63	300	25	DI
13aa3	33	60	30	D	6-20-63			
13ac	45	97	-	I	5-14-61			
13ad	-	39	10	D	5-10-40	128	26	DI
13ad2	22	62	20	D	11-6-62	1,000	27	I
13bb	15	52	2	D	9-27-61	1,000	30	S
13bb2	27	103	3	D	11-7-62	150	30	DI
13bc	15	60	8	D	12-7-61			
13bc2	15	58	10	D	10-15-61			
13dd	42	50	25	D	11-27-62			
14ba	12	48	20	D	10-5-61			
14da	125	325	10	D	12-15-62	400	265	D
14da2	150	555	40	D	10-3-62	400	265	D
14da3	125	370	18	D	9-28-62	400	265	D

Location	Depth to Water	Depth of Well	Capacity Listed	Purpose	Date Appropriated	Water Used	Depth to Water	Purpose Reported
B1-69 - Continued								
14da4	150	545	40	D	9-21-62	400	265	D
14db	165	400	25	-	7-3-63	400	265	D
14db2	125	345	12	D	11-8-62	400	265	D
14db3	14	135	10	D	11-9-62	400	265	D
14db4	30	225	12	D	9-15-62	400	265	D
15aa	10	50	3	D	9-15-61	100	10	DI
15cd	12	27	100	I	6- -32			
16dd	100	180	30	D	3-25-58			
18bd	50	154	3	D	-	-	-	-
19ab	11	21	10	D	5-10-33	1,000	11	DS
19dc	20	305	35	D	6-26-59	250	50	D
20ba	180	480	5	D	-30		243	DS
21ba	50	290	24	D	8-15-61			
21ca	15	80	20	D	10-7-60	1,000	19	DI
21ca2	18	70	20	D	5-10-60			
21cd	5	62	7	D	1-12-60			
23cb	18	458	10	D	9-8-58			
24aa	225	225	600	I	8- -46			
24aa2	-	225	10	D	8- -46			
24bb	96	282	12	D	8-13-59			
27dc	70	340	30	D	9-10-59			
31ca	5	56	30	D	9-28-59	-	-	IS
31ca2	8	76	8	D	6-24-58	0	-	-
31cc	11	48	10	D	6-14-58			
31cd	30	167	30	D	12-18-57			
31cd2	6	40	10	D	6-13-58			
31dd	-	142	Dry	D	6-22-61	10,000	200	DI
31dd2	60	135	37	D	4-4-63			
31dd3	15	150	25	D	8-30-60			
32bb	30	172	12	D	10-8-58			
32cc	36	168	10	D	8-23-61	3,000	135	DI
32cc2	24	92	15	D	4-5-61	6,000	50	I
32cc3	135	205	15	D	5-3-62	-	-	DI
32cc4	145	235	15	D	5-5-62	450	70	I
33cc	20	93	1	D	11-31-60			
34da	40	490	3	D	4-3-63	350	258	S
36cc	24	52	1	D	11-15-58			
36cc2	11	33	30	D	11-19-58			
36cd	16	28	200	I	-45			

Location	Depth to Water	Depth of Well	Capacity Listed	Purpose	Date Appropriated	Water Used	Depth to Water	Purpose Reported
B1-70								
7bc	12	75	1	D	7-16-59			
7cc	25	80	1	D	9-13-61			
7da	27	45	10	D	12-4-58			
7dc	18	76	2	D	1-13-60			
7dd	12	41	3	D	10-7-61			
7dd2	12	43	2	D	9-21-61			
7dd3	8	30	50	D	7-27-59			
8dd	60	107	2	D	4-27-62			
8dd2	13	89	2	D	9-16-61	300		DI
8dd3	21	50	8	D	2-2-61			
8dd4	18	50	7	D	12-4-57	125	45	D
8dd5	18	74	5	D	9-14-61			
8dd6	5	74	4	D	9-25-61			
8dd7	20	108	6	D	9-28-61	600	30	D
8dd8	11	92	2	D	1-26-62	125	20	DIS
8dd9	6	51	6	D	8-13-59			
8dd10	25	89	1	D	9-20-61	80	16	D
13bb	225	450	7	M	9-10-61			
13cc	9	15	510	D	10-1-61			
13cd	2	31	40	D	4-20-61			
13cd2	7	27	12	D	10-14-58	800	48	DI
14ac	8	157	10	D	2-26-58	0	13	-
14ad	4	28	9	D	3-31-58			
14ca		45	3	D	1-31-63	-	-	D
14cc	6	12	13	M	1- -56	1,000		DIS
14db	35	51	5	D	7-31-58			
15ab		14	20	D	11-1-61			
15ba	14	16	20	D	7-27-61			
15ba2	14	14	20	D	7-27-61			
15bb	9	11	40	D	11-3-62			
16bb	10	153	2	D	5-1-62			
16bd	flow	9	0	I	6- -50			
16bd2	7	13	65	D	4-18-63			
16bd3	7	12	60	D	4-18-63			
17bc	10	30	40		1-20-61			
17ca	6	45	20	D	5-25-61			
17ca2	20	60	3	D	9-8-58			
17cb	27	30	30	D	6-26-57			
17cc		64	1	D	1-15-59			
17cc2	12	31	15	D	9-21-59			
17dc	8	16	520	I				

Location	Depth to Water	Depth of Well	Capacity Listed	Purpose	Date Appropriated	Water Used	Depth to Water	Purpose Reported
B1-70 - Continued								
18aa	20	65	10	D	3-27-61			
18aa2	19	35	8	D	9-11-62			
18aa3	36	40	1	D	3-30-61			
18ab	18	60	10	D	11-21-59			
18ac	5	30	40		2-10-62			
18ac2	18	40	4	D	4-6-60			
18ac3	18	40	4	D	4-3-60			
18ac4	23	75	1	D	11-23-60			
18ac5	13	50	6	D	5-6-63			
18ac6	11	35	40	D	4-16-60			
18ac7	14	37	20	D	4-15-60			
18ac8	8	35	50	D	6-17-60			
18ac9	11	35	42	D	8-5-60			
18ac10	11	35	40	D	8-4-60			
18ac11	14	35	20	D	9-20-60			
18ac12	17	40	5	D	4-14-60			
18ad	17	60	40	D	4-17-61			
18ad2	14	36	12	D	9-16-60			
18ad3	15	35	20	D	9-21-60			
18bb	12	40	11	D	2-27-63			
18bb2	8	30	20	D	11-9-57			
18bc	7	40	15	D	3-28-62			
18bc2	6	40	20	D	9-5-58			
18bd	15	35	20	D	12-1-62			
18bd2	3	30	45	D	6-29-61			
18bd3	7	35	20	D	12-16-58			
18bd4	12	24	8	D	11-24-59			
18bd5	18	26	12	D	12-12-59			
18bd6	14	22	10	D	12-13-59			
18bd7	12	19	6	D	12-14-59	450	20	D
18ca	6	30	20	D	6-5-62			
18ca2	8	31	3	D	12-2-61			
18ca3	3	25	30	D	6-29-61			
18ca4	2	8	5	D	5-20-60			
18cb2	15	62	5	D	3-8-62	125	30	D
18cb3	14	40	7	D	3-8-62	150	20	DI
18cb4	12	40	7	D	3-10-62	150	20	D
18cb5	12	45	8	D	5-25-60	200	20	DS
18cb6	10	14	34	D	9-6-62			
18cb7	15	85	8	D	5-12-58			

[illegible]

Location	Depth to Water	Depth of Well	Capacity Listed	Purpose	Date Appropriated	Water Used	Depth to Water	Purpose Reported
B1-70 - Continued								
18cb8	15	70	1	D	10-21-58	50	20	D
18cc	30	48	7	D	6-4-62	40	40	D
18cc2	5	32	10	D	7-20-60			
18cc3	40	75	20	D	-56	35,000	22	DI
18cc4	19	40	5	D	9-6-58			
18cc5	20	40	5	D	1-18-58			
18cc6	18	40	5	D	1-18-58			
18cd	31	45	10	D	5-22-63	150	45	D
18cd2	19	42	3	D	7-29-61			
18cd3	19	42	8	D	7-27-61			
18cd4	19	42	8	D	7-28-61			
18cd5	15	40	10	D	5-13-58			
18cd6	60	100	2	D	1-1-60			
18cd7	29	45	10		3-1-63	-	45	DI
18cd8	26	43	14	D	2-20-59			
18cd9	14	43	7	D	9-9-60			
18da	6	40	4	D	10-19-62			
18da2	7	24	40	D	10-1-62			
18da3	7	32	60	D	9-10-62			
18da4	9	30	30	D	7-5-61			
18da5	9	35	12	D	1-27-61			
18da6	9	40	10	D	1-31-61			
18da7	5	30	30	D	11-3-58			
18da8	5	33	40	D	11-1-58			
18da9	5	26	30	D	11-4-58			
18da10	12	25	5	D	3-12-60			
18db	10	60	10	D	12-20-60			
18db2	8	31	20	D	3-14-61			
18db3	9	31	12	D	3-25-61			
18db4	8	28	15	D	2-18-58			
18db5	5	30	40	D	7-15-58			
18db6	6	37	40	D	8-18-58			
18db7	5	34	30	D	10-22-58			
18db8	16	30	12	D	10-20-58			
18db9	17	30	8	D	4-11-59			
18db10	12	31	20	D	7-14-59			
18db11	13	50	5	D	1-4-58	300	17	D
18db12	3	25	25	D	12-7-57			
18db13	6	26	24	D	11-9-57			
18db14	8	30	20	D	4-16-57	85	20	D

Location	Depth to Water	Depth of Well	Capacity Listed	Purpose	Date Appropriated	Water Used	Depth to Water	Purpose Reported
B1-70 - Continued								
18db15	32	35	40	D	8-27-57			
18db16	10	30	40	D	2-7-59			
18db17	11	37	15	D	1-8-60			
18dc	21	37	8	D	5-7-63	30	21	DI
18dc2	7	44	18	D	5-5-63			
18dc3	10	31	40	D	11-15-61			
18dc4	14	60	8	D	1-6-60			
18dc5	21	40	4	D	5-29-59			
18dc6	14	30	20	D	7-6-59			
18dd	12	75	2	D	4-29-63			
18dd2		40	Dry	D	6- -59			
19aa	4	71	6	D	3-15-58			
19aa2	8	60	1	D	5-27-61			
19ab	12	32	20	D	1-26-62			
19ab2	40	105	2	D	3-13-62			
19ab3	15	60	1	D	10-28-61			
19ab4	15	60	1	D	10-20-61			
19ab5	14	35	15	D	12-3-62			
19ab6	6	50	1	D	5-15-62			
19ab7	5	135	1	D	3-15-62			
19ab8	13	35	25	D	11-30-62	-	13	-
19ab9	37	40	1	D	7-18-57			
19ab10	8	35	48	D	8-8-60	200	18	D
19ab11	4	10	20	D	4- -54			
19ab12	18	40	20	D	8-26-62			
19ba	15	42	24	D	1-25-62			
19bb	3	75	1	D	11-15-61			
19bb2	18	30	6	D	11-2-58			
19bb3	14	74	80	D	6-14-60			
19bc	3	18	40	D		450	7	DI
19bd	25	45	12	D	6-3-59			
19ca		37	30	D	10-5-57			
19ca2	20	13		I				
19cb	15	65	125	I	5-25-55	60,000	15	I
19cc	11	30	30	D	5-11-62			
19cc2	13	35	50	DI	12-4-62	27,500	11	I
19cd	11	35	40	D	9-17-62			
19cd2	8	16	5	D	1- -55			
19cd3	37	41	50	D	7-2-57	10,000	40	I
19da	7	35	40	D	10-8-58			
19da2	5	17	10	C	5-15-59			

Location	Depth to Water	Depth of Well	Capacity Listed	Purpose	Date Appropriated	Water Used	Depth to Water	Purpose Reported
B1-70 - Continued								
19da3	6	25	20	D	10-26-57			
19db	7	30	25	DI	4-20-63			
19db2	2	34	45	D	9-26-60			
19db3	7	35	12	D	12-15-60	1,000	30	I
19db4	3	35	30	D	10-1-56			
19dc	9	40	20	DI	4-28-61			
19dd	4	32	5	D	-40	200	40	I
19dd2	8	31	28	DI	5-25-63	-	31	I
20aa	17	35	3	D	10-15-62			
20ba	14	40	3	S	12-26-58			
20bb	40	100	1	D	2-28-63	200	20	D
20bb2	14	37	15	D	5-23-63			
20bc	9	30	25	D	11-24-58			
20cb	8	24	50	D	-56	150	24	D
20cb2	8	31	20	D	4-25-59			
20cb3	7	31	20	D	4-6-59			
20cc	12	28	12	D	12-10-58			
20cc2	5	36	2	D	7-28-58	300	32	D
20cd	7	30	20	D	10-5-62	-	87	D
20da	22	25	10	D	8-5-57			
20db	6	35	5	D	11-19-62	300	6	D
20db2	5	31	45	D	4-2-63	400	6	D
20dc	50	65	10	D	-40			
20dc2	8	15	5	D	-40	75	-	D
21ad		12		D	5-25-61			
21cb	8	12	10	D	11-20-62	60	12	DI
21cb2	8	76	1	D	10-6-58			
21cc	16	35	4	D	1-7-63			
21dc	12	32	30	C	3-16-61			
21dc2	14	30	28	D	3-25-61	11,500	30	S
22ab			673	I	5- -52			
22ab2	7	36	5	D	4-25-59			
22ad	10	29	8	D	5-26-58			
22bc	3	12	2000	I	4- -59			
22cd	10	26	20	D	4-28-60			
22cd2	8	30	25	D	7-11-59			
22db	8	11	14	D				
22db2	5	10	10	D	4- -49			
22db3	7	30	14	D	3-29-61			
22dc	6	31	25	D	9-23-59	-	30	D

Loca- tion	Depth to Water	Depth of Well	Capaci- ty Listed	Pur- pose	Date Appro- priated	Water Used	Depth to Water	Pur- pose Report- ed
B1-70 - Continued								
22dd	5	25	20	D	10-16-58	400	13	D
23bc	2	13	1000		4- -59			
23bc2	4	28	5	D	4-8-61	100	5	IND
23ca	21	36	32		4-7-63			
23da	16	35	10	D	10-24-58			
23da2	22	56	6	D	9-26-59			
23da3	25	63	10	D	5-16-61	100	20	DI
23dd	21	47	5	D	6-9-58			
24ac	140	152	5	S	9-28-57			
24ba	3	30	12	D	5-23-60			
24ba2	3	25	40	D	7-14-59	-	4	DIS
24ba3	1	18	25	D	7-9-58			
24db	30	155	9	D	2-7-62	200	30	D
24dd	7	30	30	D	10-6-62			I
25cb	28	55	20		3-26-58			
25cd	12	43	15	D	6-30-61	175	20	D
25cd2	40	57	30	D	10-19-59			
25da	flow	22	30	C	-48			
25da2	flow	37	30	C	-48			
25da3	flow	42	40	C	-48			
25db	40	65	20	D	2-26-58			
26ad	20	152	4	D	8-14-62			
27ac	4	31	10	D	5-1-62			
27bb	2	16	2000	IS	7- -59			
27cb	2	14	750	I	4- -51			
27cc	5	28	30	IND	1-29-59			
27cc2	5	28	30	D	5-20-58			
27cc3	3	51	6	D	9-19-59			
27cc4	4	30	10	D	11-28-61			
28cd	14	39	2	D	8-8-63			
28db	8	38	25	IND	6- -57	100	20	D
28db2	5	31	35	D	6-21-60			
28db3	5	31	10	D	9-26-62			
28dc	6	27	9	D	3-5-60			
28dc2	4	30	20	D	4-28-59			
28dc3	5	40	35	D	12-16-59	1,200	10	I
28dc4	2	30	40	C	6- -56	1,000	10	I
28dc5	5	32	30	D	10-28-	300	-	DI
28dd	6	30	12	D	3-2-63	-	30	D
28dd2	1	35	20	IND	-57	28,800	21	D
28dd3	8	32	6	D	5-10-62			

Location	Depth to Water	Depth of Well	Capacity Listed	Purpose	Date Appropriated	Water Used	Depth to Water	Purpose Reported
B1-70 - Continued								
28dd4	27	30	10	D	6-24-57			
28dd5	8	30	15	IND	2-8-62			
28dd6	4	26	35	D	11-25-61	100	15	DI
29aa	15	30	10	D	3- -63			
29ac	4	26	25	D	12-20-60			
29ac2	3	21	8	D	11-4-59			
29ac3	5	30	3	C	8-21-62	40	-	D
29ba	6	31	40	D	10-20-62			
29ba2	9	30	12	D	3-5-63			
29ba3	6	30	10	D	1-11-60			
29bb	6	25	36	C	5-4-57			
29bc	6	20	10	DI	5-21-63			
29bd	4	30	6	D	5-27-60	-	30	D
29bd2	5	27	14	D	3-26-60			
29bd3	4	25	10	D	4-26-61			
29bd4	8	30	30	D	11-19-58			
29ca	3	30	30	D	4-13-61	8,500	12	D
29ca2	4	28	40	D	8-21-58			
29cb	5	30	30	D	7-3-58			
29cc	10	17	500	C	5- -55			
29cc2	2	30	23	D	6-6-60			
29cd	6	24		C	10-14-59			
29cd2	5	31	35	D	11-3-59	400	140	DI
29da	4	27	20	D	3-31-61			
29da2	6	31	6	D	9-27-62			
29da3	4	26	8	D	6-12-61	100	3	DI
29da4	5	26	30	D	2-11-61			
29da5	4	26	35	D	2-10-61	15	10	D
29db	4	30	28	D	3-4-59	15	10	DI
30aa	14	22	5	D	8- -49	150	14	DI
30aa2	13	18	4	D	5- -19	150	14	D
30ac	6	30	15	DI	5-17-63			
30ba	8	31	42	D	7-8-63			
30ba2		40		D		5	8	D
30bb	12	20	2	D	5-20-63			
30bb2	14	38	40	D	5-14-62			
30bb3	12	32	40	D	4-19-61			
30bb4	14	35	35	D	5-20-63			
30ca	16	16	11	C	2-15-61			
30cc	2	6	10	C	6- -48			

[illegible]

Location	Depth to Water	Depth of Well	Capacity Listed	Purpose	Date Appropriated	Water Used	Depth to Water	Purpose Reported
B1-70 - Continued								
30db	6	10	10	D	7- -54			
30dc	5	31	40	D	5-3-60			
30dd	9	31	5	DI	11-21-62			
30dd2	7	30	20	D	10-8-62		8	I
32ba	5	30	20	C	3-30-60			
32ba2	15	20	15	D	1-30-61			
32ba3	6	26	30		4-22-59			
32ba4	5	26	10	D	-52	50	5	DI
32bb	10	30	40	D	3-29-60			
32bc	4	6	12	DI	6-1-63	75	8	I
33aa	20	23	20	D	6-21-57	1,000	3	D
33aa2	4	31	15	D	9-15-59			
33aa3	4	31	30	D	9-17-59			
33aa4		25	10	D	1-28-58			
33da	9	20	10	D	3-14-63	2,500	8	I
33dc	4	20	100	D	5- -58			
33dc2	6	20	20	D	4- -58			
33dd	6	17	10	D	5-21-63	750	10	I
33dd2		30	8	D	10-8-57			
33dd3	8	26	6	D	2-24-58			
33dd4	6	17		D	6-23-58	400	5	I
33dd5	7	15	10	D	5-12-61	2,000	10	I
33dd6	4	21	35	D	8- -56			
33dd7	5	20	25	D	8- -56			
33dd8	5	21	40	D	8- -56			
33dd9	5	22	35	D	8- -56			
33dd10	4	20	55	D	8- -56			
33dd11	5	21	40	D	8- -56			
33dd12	4	20	40	D	8- -56			
33dd13	7	15		D	2-18-60			
34aa	5	31	4	D				
34aa2	2	31	8	D	8-5-58			
34aa3	3	35	10	D	6-17-58			
34ac	4	28	25	D	3-16-62			
34ac2	3	75	2	D	6-11-58			
34ac3	68	74	1	D	3-12-58			
34ac4	30	75	30	D	7-22-58	500	20	D
34ac5	4	75	1	D	1-6-58			
34ac6	4	75	2	D	1-3-58			
34ac7	7	32	4	D	10-10-58			

Location	Depth to Water	Depth of Well	Capacity Listed	Purpose	Date Appropriated	Water Used	Depth to Water	Purpose Reported
B1-70 - Continued								
34bb	3	25	25	D	6-7-60			
34bb2	6	23	10	D	6-2-58			
34bb3	4	30	9	D	11-24-61			
34bb4	4	30	10	D	6-1-62			
34bb5	4	14	30	D	11-16-52	1,500	6	D
34cb	5	31	15	D	10-24-62			
34cc	3	27	12	D	7-22-61			
34cc2	4	30	15	D	7-28-63	-	10	I
34cd	5	27	5	D	7-24-58	450	15	D
34dc	4	10		D	3-9-61	80	8	I
34dc2	4	65	16	D	1-9-59			
34dc3	5	65	1	D	1-14-59			
34dc4	6	67	1	D	8-13-58			
34dd	8	40	12	D	8-4-61			
34dd2	8	51	12	D	3-21-58	500	30	DI
34dd3	8	63	5	D	5-6-58	300	9	D
35ad	50	175	2	D	4-22-61	-	50	-
35cd		242	20	D	-56			
35cd2		235	20	D	6- -56			
35cd3		200	15	D	8- -54			
35cd4		200	10	D	6- -54			
35cd5	17	170	2	D	4-28-58	300	50	D
35da	25	80	10	D	2-9-63			
35da2	32	90	3	D	8-24-62			
35dc	30	152	4	D	11-3-60	250	135	D
35dc2	60	150	6	D	1-24-61			
35dc3	35	142	6	D	5-28-60	320	152	D
35dc4	55	157	7	D	5-2-61	550	35	DI
35dc5	40	158	10	D	10-18-61	400	40	DI
35dc6	30	124	1	D	4-6-62			
35dc7	30	154	4	D	9-17-62			
35dc8	40	154	8	D	9-16-62			
35dc9		100	dry	D	4-28-63			
35dc10	25	145	2	D	7-1-63			
36ab	10	50	10	D	2-18-63			
36bd	12	54	10	D	3-28-63			
36cd	10	105	7	D	10-31-62			
36dc	18	140	15	D	8-9-63			
36dc2	30	200	15	D	8-10-63			
36dc3	18	140	10	D	8-9-63			

Location	Depth to Water	Depth of Well	Capacity Listed	Purpose	Date Appropriated	Water Used	Depth to Water	Purpose Reported
B1-70 - Continued								
36dd	6	90	20	D	8-27-60			
36dd2	60	200	1	D	4-21-63			
36dd3	18	123	20	D	3-1-63			
36dd4	45	200	20	D	3-4-63			
36dd5	26	200	25	D	3-2-63			
36dd6	28	135	10	D	3-28-63			
36dd7	22	200	20	D	4-19-63			
36dd8	20	200	20	D	4-18-63			
36dd9	26	180	40	D	5-27-63			
B1-71								
8ab	90	230	20	D	3-31-62	2,880	-	DI
11aa	10	55	3	D	4-1-62	500	14	DI
11aa2	60	205	3	D	1-21-63			
11aa3	35	207	2	D	2- -63			
11aa4	12	200	1	D	6-8-62			
11aa5	11	185	10	D	6-12-62			
11ba	50	123	2	D	11-2-62	240	80	D
12bb	25	40	10	D	11-20-61			
12bc	50	315	12	D	12-12-62			
12ca	60	130	15	D	8-10-63			
12cb	12	27	55	D	8-7-63	700	134	D
12cc	10	26	10	D	1-16-60			
12da	18	51	1	D	3-19-58			
12db	13	36	17	D	6-30-61	600	6	D
12db2	45	179	1	D	2-18-62			
12dc	5	32	9	D	4-27-62	200	40	D
12dc2	20	42	10	D	10-4-62			
12dd	14	40	2	D	4-17-59			
13aa	4	45	8	D	7-8-60			
13aa2	25	28	20	D	6-24-57			
13aa3	10	35	25	D	3-16-59			
13ab	6	31	30	D	3-11-60			
13ac	12	70	1	D	10-4-60			
13ad	10	35	25	D	10-7-61			
13ad2	9	29	20	D	9-30-60			
13ad3	12	25	3	D	1-2-60			
13ad4	8	25	12	D	12-4-58	-	22	DI
13ad5	7	30	15	D	6-22-62			

Location	Depth to Water	Depth of Well	Capacity Listed	Purpose	Date Appropriated	Water Used	Depth to Water	Purpose Reported
B1-71 - Continued								
13ad6	10	81	1	D	9-28-60			
13dd	4	29	40	D	9-5-58	250	6	DI
14bb	9	255	1	D	3-21-63	-	253	-
14bd		240	1	D	10-27-61			
14bd2	69	210	1	D	10-20-61			
14cb	85	240	1	D	12-28-61			
14cc	30	122	1	D	5-26-62			
14cc2	22	106	1	D	5-23-62			
14cc3	44	196	1	D	6-29-62			
14cc4	56	92	6	D	10-14-61			
15ad	65	230	1	D	12-14-61			
15ad2	24	180	1	D	2-6-63			
15cb	26	80	1	D	5-28-58			
15cb2	80	140	3	D	3- -63			
16ac	48	75	2	D	7-17-61			
17ab	23	78	1	D	3-20-62			
17ad	70	178	10	D	3-23-62			
18bc	21	55	1	D	11-21-62			
18cd	106	167	1	D	4-8-63			
19cc	28	63	7	D	4-16-63			
19cd	78	233	1	D	4-15-63			
22bd	35	230	15	-	7-9-62			
22ca	41	80	3	D	5-21-63			
22dd	35	157	1	D	3-10-60	100	-	D
23aa	50	258	1	D	3-29-62			
23cb	150	290	1	D	2-15-62			
23cc	8	143	2	D	6-10-59	250	48	D
23cc2	125	130	2	D	11-7-62			
23cc3	60	100	4	D	12- -62			
23cc4	60	140	1	D	2-9-62			
24aa	18	48	20	D	6-16-60			
24aa2	18	48	20	D	10-25-58			
24ab	21	53	1	D	8-10-60	100	25	DI
24ab2	8	31	21	D	7-17-61	150	25	DS
24ac	7	38	33	D	8-24-62			
24ad	9	37	15	D	8-24-62			
24ad2	20	25	15	D	-51	50	28	I
24ad3	17	34	4	D	1-7-61			
24ad4	15	60	5	D	4-10-59			
24ba	16	30	2	D	2-3-62			

[illegible]

Location	Depth to Water	Depth of Well	Capacity Listed	Purpose	Date Appropriated	Water Used	Depth to Water	Purpose Reported
B1-71 - Continued								
24da	22	42	10	D	4-26-63			
24db	-	20	12	D	9- -57	5,000	8	I
24db2	10	56	10	D	-49			
24dc	20	60	7	D	5-13-63	2,400	58	I
25aa	15	40	10	D	3-1-63	-	-	I
25aa2	15	40	10	D	2-28-63	-	30	I
25ab	12	34	6	D	4-18-63			
25ba	60	70	2	D	4-13-61	300	171	I
25dc	36	335	3	D	3-15-61	-	-	I
25dc2	19	46	8	D	5-1-61			
25dd	10	30	17	D	4-26-60			
26aa	80	224	1	D	6-5-59			
26ab	41	93	2	D	4-6-62			
26bb	50	155	1	D	11-26-62	200	155	D
26bb2	27	122	1	D	1-26-63	300	20	D
26bb3	115	515	1	D	11-18-60	200	-	D
26bb4	90	315	30	D	4-6-60	400	90	D
27aa	35	250	1	D	10- -62	300	35	DI
27bb	10	90	2	D	6-18-59			
27bd	9	50	7	D	4-8-58			
31db	25	230	3	D	1-8-63	500	75	D
32ca	11	30	1	D	9-25-59	-	27	D
33ba	30	135	4	D	3- -63			
33bb	70	185	3	D	4-12-63			
33bb2	40	216	1	D	2-25-63			
33bb3	50	140	6	D	12- -62			
33bb4	50	195	1	D	1-13-62	200	40	DI
33bb5	-	290	1	D	4-21-62			
33ca	14	24	15	D	9-21-59			
33cb	30	200	15	D	6-14-62			
33cc	10	125	1	D	4-11-62			
33da	4	15	25	D	11-27-57			
36aa	8	20	35	D	5-18-63	-	35	I
36ab	12	31	42	D	4-18-61			
36ba	21	36	8	D	11-22-57			
36bb	18	32	13	I	-49			
36bb2	48	90	15	D	3-28-60			
36db	8	21	7	D	5-14-63			
36db2	15	36	12	D	3-15-63	5,000	25	I
36db3	4	30	30	D	4-2-63	7,000	25	I

Location	Depth to Water	Depth of Well	Capacity Listed	Purpose	Date Appropriated	Water Used	Depth to Water	Purpose Reported
B1-71 - Continued								
36dd	3	40	10	D	3-8-63	0	-	I
36dd2	3	39	10	D	3-5-63	0	17	-
B1-72								
10dc	53	180	8	D	8-18-61			
12cb	190	270	1	D	7-12-61	120	50	D
18da	5	30	15	D	6-26-59			
22ca	3	25	9	D	11-26-60			
24bc	15	28	6	D	10-30-58			
25ac	22	57	27	D	3-14-58			
25db	-	30	10	D	4- -58			
25dd	30	166	1	D	6-12-63			
36bb	20	110	1	D	1-5-61	250	100	D
B2-68								
17dc	30	213	10	I	5-12-59			
29bc	5	20	1350	I	7- -59	1,280,000*	5	I
31ca	127	392	9	D	7-3-62			
B2-69								
25ad	40	200	15	D	5-11-59	2,000	70	DIS
C1-69								
2aa		229	500	I	5-27-54			
2cc	20	215	1001	I	6-1-54	900	19	I
3aa	150	215	15	D	10-12-62			
3ad	12	29	15	D	10-13-62			
3ca	31	480	10	D	1-30-60			
3cb	15	32	278	I	2- -17			
3da	14	75	8	D	6-29-60	1,500	70	D
4bb	60	300	20	D	5-11-60			
4bb2	175	520	8	D	1-19-61	400	120	D
4bb3	180	480	10	D	9-21-62	100	-	DI
4bb4	85	498	15	D	6-13-62			
4bb5	150	435	18	D	5-23-62			
4bc	20	50	20	D	-55	-	65	I
4cc	97	400	10	D	10-20-59	250	100	D
5aa	4	35	35	D	8-27-59			
5bb	60	145	25	D	6-21-63			

Location	Depth to Water	Depth of Well	Capacity Listed	Purpose	Date Appropriated	Water Used	Depth to Water	Purpose Reported
C1-69 - Continued								
5bb2	37	137	25	D	6-26-63			
5bb3	20	90	1	D	9-3-60	50	50	DI
5bb4	16	108	15	D	10-10-60			
6cc	-	880	Dry	D	10-14-59			
6cc2	25	165	90	D	3-30-60			
6cc3	25	165	1	D	4-28-60			
7aa	160	647	10	D	1-18-58			
8ba	-	300	Dry	D	3-31-62			
8da	8	20	30	D	-			
8da2	8	22	8	D	-			
9bb	35	254	200	I	-			
9ca	10	20	900	I	5-1-32			
10bb	10	170	1200	I	-41	4,400	20	S
10da	160	469	9	D	6-5-58			
10dc	14	31	10	D	6-20-59			
10dd	180	575	10	D	6-23-61			
12ad	350	362	15	D	7-4-57	2,000	75	DI
12dd	105	360	20	D	4-26-63			
12dd2	50	325	12	D	5-9-59			
12dd3	165	330	15	D	8-6-63			
12dd4	200	300	15	D	7-2-57			
14cc	50	440	943	I	10-1-32	500	40	DIS
16bb	-	-	-	D	-	800	335	D
16cb	8	25	30	D	1- -05			
16cb2	9	65	40	D	3- -57			
16cc	200	500	10	D	9-1-61			
16cc2	155	475	15	D	8-9-61			
16cc3	260	525	15	D	8-12-63			
16dc	200	548	10	D	6-30-62			
17ab	15	26	27	D	3- -55			
17ab2	15	22	27	D	2- -27			
17cc	97	154	1000	I	7-7-55			
17cc2	9	42	35	D	3- -57			
17cc3	9	24	30	D	1- -54			
17dc	12	38	180	I	4-3-52			
17dc2	9	25	30	D	-01			
18bb	95	200	18	D	8-8-60			
18bb2	114	709	32	D	8-17-60			
18cb	14	34	20	D	9-24-60			
19aa	14	20	150	D	-54			
19aa2	3	8	150	D	-55			

Loca- tion	Depth to Water	Depth of Well	Capaci- ty Listed	Pur- pose	Date Appro- priated	Water Used	Depth to Water	Pur- pose Report- ed
C1-69 - Continued								
19aa3	5	15	300	I	-54			
19aa4	15	20	150	D	-20			
19aa5	15	20	150	D	-20			
19aa6	250	500	10	D	10-5-62			
20dd	300	625	12	D	6-14-63	3,000	300	DS
21ab	1	25	400	I	-40			
21bb	198	496	10	D	6-28-62			
22da	150	650	20	D	9-19-58			
23bb	180	668	25	D	7-10-62	200	40	D
23bb2	212	590	15	D	7-23-58			
27ba	-	200	Dry	D	-			
27dd	140	390	15	D	7-21-61			
29cc	150	615	12	D	5-19-63			
30bd	50	185	20	D	4-4-61			
32ab	200	410	10	D	5-16-59	300	410	D
C1-70								
1aa	50	185	10	D	2-19-60			
1aa2	68	197	10	D	3-7-60			
1aa3	30	123	10	D	11-18-60			
1aa4	60	315	20	D	7-21-60			
1aa5	60	300	15	D	12-3-59			
1aa6	40	195	20	D	4-24-60			
1aa7	40	180	10	D	10-5-59			
1aa8	120	152	35	D	10-15-57	-	18	I
1aa9	73	120	15	D	1-31-61			
1aa10	60	150	10	D	11-23-60			
1aa11	60	175	12	D	5-5-59			
1aa12	10	102	10	D	7-10-59			
1aa13	20	152	35	D	11-20-57			
1aa14	20	150	15	D	7-28-59			
1aa15	10	152	30	D	2-18-58			
1aa16	20	135	20	D	3-19-59			
1aa17	15	95	20	D	4-24-59			
1aa18	20	100	10	D	6-9-59			
1aa19	21	100	12	D	6-9-59			
1aa20	25	110	20	D	6-12-59			
1aa21	8	150	30	D	7-17-58			
1aa22	15	150	25	D	6-12-58			
1aa23	8	150	30	D	6-26-58			

Loca- tion	Depth to Water	Depth of Well	Capaci- ty Listed	Pur- pose	Date Appro- priated	Water Used	Depth to Water	Pur- pose Report- ed
C1-70 - Continued								
1aa24	35	100	18	D	6-26-62			
1aa25	40	80	20	D	4-25-62			
1aa26	25	153	25	D	3-31-62	900	70	DI
1aa27	40	167	18	D	8-3-61			
1aa28	70	240	15	D	8-16-61			
1aa29	30	210	30	D	6-8-63	400	55	DI
1aa30	22	100	20	D	6-19-63			
1aa31	30	40	3	D	6-2-62			
1aa32	80	150	15	D	1-23-64	3,000	130	DI
1aa33	25	90	10	D	10-7-63	1,500	60	DI
1ac	40	200	15	D	8-10-63	15	10	D
1ac2	5	81	15	D	4-2-59	150	5	DI
1ad	27	95	30	D	11-28-58			
1ad2	27	96	35	D	8-4-59			
1ad3	60	115	35	D	8-7-59	10,520*	-	D
1ad4	40	106	35	D	8-1-59			
1ad5	25	55	15	D	6-22-60			
1ad6	40	132	15	D	1-18-60			
1ad7	12	92	30	D	10-11-58			
1ad8	63	184	15	D	7-2-63			
1ad9	60	250	50	D	6-16-60	300	100	I
1ad10	18	65	15	D	3-20-61			
1ad11	57	115	15	D	3-14-62			
1bb	32	153	18	D	3-22-62			
1bb2	28	150	20	D	3-20-62			
1bb3	30	153	15	D	3-19-62			
1bb4	25	205	20	D	5-15-63			
1bb5	22	175	18	D	6-18-63			
1ca	9	45	2	D	10-6-63			
1ca2	80	175	25	D	10-28-63			
1ca3	85	175	15	D	10-29-63			
1ca4	11	120	12	D	4-20-60	4,000	6	DI
1ca5	12	90	14	D	8-25-60			
1ca6	15	75	50	D	3-31-59			
1cc	16	210	18	D	9-3-58			
1cc2	7	60	15	D	5-5-59			
1cc3	60	210	15	D	9-22-60			
1cc4	20	126	12	D	8-24-60			
1cc5	30	195	5	D	3-28-61			
1cc6	40	235	15	D	7-23-63			
1cc7	50	252	15	D	7-19-63			

Loca- tion	Depth to Water	Depth of Well	Capaci- ty Listed	Pur- pose	Date Appro- priated	Water Used	Depth to Water	Pur- pose Report- ed
C1-70 - Continued								
1cc8	50	150	7	D	11-17-63			
1cc9	80	270	10	D	1-23-64			
1cc10	50	300	10	D	1-28-63	8,640	10	DI
1cc11	70	300	10	D	3-27-63			
1cc12	60	245	18	D	4-6-63			
1cc13	60	175	10	D	11-2-63			
1cc14	40	290	18	D	6-12-63			
1cc15	40	250	5	D	12-20-62			
1cc16	20	220	5	D	7-12-62			
1cc17	40	240	12	D	9-1-62			
1cc18	60	175	9	D	2-19-63			
1cc19	30	260	4	D	4-6-62			
1cc20	40	240	10	D	8-1-62			
1cc21	22	200	3	D	6-21-62			
1cc22	17	160	5	D	6-22-62			
1cc23	45	240	15	D	6-23-62			
1cc24	22	250	8	D	6-24-62			
1cc25	35	275	10	D	6-25-62			
1cc26	20	250	10	D	2-15-62			
1cc27	flow	150	10	D	2-14-62			
1cc28	18	60	20	D	3-16-62			
1cc29	35	270	10	D	10-5-61			
1cc30	20	155	10	D	2-8-62			
1cc31	20	155	10	D	2-8-62			
1cc32	40	210	15	D	6-28-61			
1cc33	24	150	10	D	4-10-61			
1cc34	20	240	5	D	3-6-61			
1cc35	20	285	5	D	2-29-61			
1cc36		225	20	D	7-21-61			
1cc37		225	15	D	8-12-61			
1cc38	4	200	10	D	9-5-61			
1cc39	3	175	18	D	7-25-61			
1cd	10	155	9	D	5-21-61			
1cd2	10	101	30	D	7-26-61			
1cd3	8	136	12	D	6-10-61			
1cd4	28	125	12	D	1-2-62			
1cd5	6	55	40	D	11-21-61			
1cd6	37	222	12	D	5-31-62			
1cd7	19	178	12	D	6-8-62			
1cd8	65	208	8	D	7-24-62			
1cd9	38	317	20	D	10-9-62			

Location	Depth to Water	Depth of Well	Capacity Listed	Purpose	Date Appropriated	Water Used	Depth to Water	Purpose Reported
C1-70 - Continued								
1cd10	85	90	20	D	7-26-57	2,000	25	DI
1da	20	245	8	D	10-4-59			
1da2	25	255	15	D	10-14-59			
1db	4	54	6	D	6-24-59			
1db2	3	81	11	D	3-27-58			
1db3	5	78	9	D	5-22-58	1,200	15	DI
1db4	12	88	15	D	11-9-62			
1db5	40	250	15	D	12-5-59			
1dd	30	200	7	D	5-30-61			
1dd2	20	235	6	D	6-6-61			
1dd3	30	210	6	D	7-18-61			
1dd4	30	200	8	D	4-27-62			
1dd5	40	210	5	D	5-3-62			
1dd6	30	195	6	D	3-7-62			
1dd7	25	270	12	D	4-29-63			
1dd8	60	250	15	D	4-8-63			
1dd9	20	200	2	D	4-10-63			
1dd10	26	300	8	D	4-16-63	200	70	DI
1dd11	59	190	12	D	5-13-63	60	70	DI
1dd12	40	200	20	D	9-18-63			
1dd13	32	425	8	D	12-18-62			
1dd14	40	300	10	D	12-22-62			
1dd15	70	240	10	D	7-14-62			
1dd16	60	300	20	D	3-22-63			
1dd17	30	250	5	D	12-2-62			
1dd18	68	270	10	D	12-7-62			
1dd19	30	270	4	D	12-9-62			
1dd20	100	270	12	D	1-25-64			
1dd21	32	190	12	D	1-25-60	600	150	DI
1dd22	21	150	8	D	3-2-61			
1dd23	29	135	8	D	2-28-61			
1dd24	8	55	15	D	1-18-61			
1dd25	4	185	4	D	8-23-60			
1dd26	8	182	15	D	8-27-60			
1dd27	12	185	6	D	9-2-60			
1dd28	30	165	4	D	2-10-61			
1dd29	25	180	3	D	2-13-61			
1dd30	30	180	3	D	2-9-61			
1dd31	25	180	25	D	2-15-61	-	-	DI
2ab	12	12	100	C	1-1-58			
2ab2	7	14	150	C	3- -58			

Location	Depth to Water	Depth of Well	Capacity Listed	Purpose	Date Appropriated	Water Used	Depth to Water	Purpose Reported
C1-70 - Continued								
2cb	Flow	255	35	D	5-28-59			
2cc	190	200	20	D	12-6-57			
2dc	32	50	15	D	5-13-63			
2dc2	10	45	60	I	6-1-55			
4ab	5	25	10	D	12-16-58			
4dd	4	32	10	D	7-10-59			
5aa	6	27	18	D	11-25-58			
5aa2	6	30	10	D	9-15-58	-	15	I
5aa3	3	31	40	D	3-30-59			
5aa4	6	30	40	D	5-12-59	-	5	DI
5aa5	10	32	25	D	3-18-59			
5aa6	4	30	24	D	5-20-60			
5aa7	4	30	20	D	5-19-60			
5aa8	2	32	30	D	5-16-58			
5aa9		23		D	6-11-62			
5aa10	Flow	35	10	D	3-23-62	100	16	D
5aa11	1	38	40	D	5-17-60			
5aa12	5	31	40	D	6-2-60			
5ad	12	31	7	D	10-16-59			
5bb	8	16	20	C	7-15-63			
5bc	10	36	3	D	6-26-63			
5bd	2	25	30	D	7-11-61			
5bd2	13	45	12	D	4-28-61			
5cb		40	Dry	D	2-28-63	Dry		
5cb2	11	17	6	D	7-19-63	-	11.5	I
5cd	6	54		D	3-15-63		26	I
6ab	3	60		D	2-16-63			
6ac	7	26	10	D	10-2-62	900*	9	I
6ac2		165	Dry	D	10-4-62			
6ad		70	Dry	D	7-20-61			
6ba	15	28	5	D	7-2-63			
6ba2	11	41	5	D	5-1-63			
9cc	30	107	3	D	9-22-61	-	35	D
10dc	5	45	20	D	11-18-61			
10dc2	10	50	10	D	3-25-61			
10dd	20	100	10	D	8-20-62			
11aa	8	45	15	D	8-27-59			
11aa2	10	130	1	D	10-27-59			
11cc	30	325	18	D	8-30-62			
12aa	150	285	20	D	7-9-63			
12aa2	25	225	2	D	8-8-63			

Location	Depth to Water	Depth of Well	Capacity Listed	Purpose	Date Appropriated	Water Used	Depth to Water	Purpose Reported
C1-70 - Continued								
12aa3	65	390	5	D	6-2-61			
12aa4	40	317	20	D	11-19-57			
12aa5	140	300	25	D	5-2-59			
12aa6	22	800	15	D	3-17-59			
12aa7	66	232	3	D	9-10-60	350	25	D
12ab	80	333	9	D	1-10-62			
12bc	99	335	10	D	11-13-62			
12bd	80	290	10	D	1-5-62			
12bd2	90	362	18	D	9-4-59	-	200	DI
12bd3	80	350	10	D	12-11-59			
12bd4	110	350	15	D	11-21-61			
12ca	45	285	10	D	5-11-61			
12ca2	50	300	14	D	3-22-60			
12ca3	80	310	9	D	8-15-59			
12cc	50	355	12	D	2-23-59			
12cc2	60	350	10	D	1-8-60			
12cc3	100	320	15	D	6-27-61			
13cc	25	95	5	D	4-6-62			
13cc2	63	130	10	D	6-30-59			
13cd	11	76	2	D	4-6-59			
13db	34	130	7	D	5-5-58			
13db2	10	87	15	D	4-28-62			
13db3	15	133	9	D	3-9-63			
13db4	17	100	20	D	9-29-62			
13dc	11	74	30	D	2-13-62			
14dd	65	116	30	D	10-14-61			
14dd2	35	86	48	D	5-15-60			
14dd3	181	239	30	D	5-22-60			
15ab		301	18	D	11-9-61	980	270	DI
15ca	58	283	7	D	5-10-60			
16aa	8	75	12	D	7-16-59	75	10	DS
16ca	5	28	12	D	1-20-59			
16cd	2	30	12	D	1-14-59	-	-	DI
16dc	20	73	5	D	8-2-58			
16dc2	18	76	15	D	6-1-60	600	-	D
16dc3	4	21	20	D	10-25-60			
20cc	22	27	60	D	9-10-57			
20cc2	5	25	8	D	6-23-61	500	7	DI
20da	4	69	8	D	8-3-61			
20da2	4	8	1	D	8-15-61			
20da3	6	16	50	D	4-13-62	100	6	D
20da4	6	30	25	D	11-14-60	300	30	DIS

Location	Depth to Water	Depth of Well	Capacity Listed	Purpose	Date Appropriated	Water Used	Depth to Water	Purpose Reported
C1-70 - Continued								
20da5	7	75	1	D	7-29-59	-	7	DI
20dc	7	70	1	D	11-9-60			
20dc2	6	25	11	D	10-14-61			
21bb	65	195	5	C	6-12-58			
21bd	60	215	8	C	1-16-61			
24ac	4	12	800	I	5- -30			
26aa	45	125	2	D	7-14-62			
29ba	3	28	30	D	7-1-58			
29bb	8	25	14	D	3-20-58			
29bb2	2	12	5	D	3-8-62			
30ac	30	70	2	D	10-4-63	150	19	DI
30ac2	1	10	890	I	88			
30ac3	5	30	225	I	05			
30bc	20	52	4	D	5-2-61			
30ca	20	155	1	D	9-27-63	24	42	
30cb	6	23	10	D	6-16-59			
33bc	17	74	1	D	2-26-59			
36ab	40	100	1	D	4-12-63			
C1-71								
3da	15	112	4	D	7-28-60			
8cc	35	95	2	D	8-10-62			
12da	Flow	615	35	D	8-3-59			
15bb	50	213	1	D	5-24-63			
15bb2	69	210	1	D	5-10-63			
15bb3	126	168	1	D	8-10-62			
15bb4	27	137	1	D	4-17-62			
15bb5	18	110	1	D	8-24-61			
15bb6	42	140	2	D	8-26-61			
15bb7	15	150	2	D	4-20-61			
15bb8	17	51	50	D	5-27-59			
15bc	137	212	1	D	8-17-63			
15bc2	12	153	1	D	4-14-62	1,100	40	DI
15bc3	48	197	1	D	10-31-62	450	32	D
15bc4	20	137	1	D	4-20-62			
15cb	12	110	2	D	5-31-62	-	-	D
15cd	40	150	3	D	2-23-63	7,200*	152	D
16db	35	137	1	D	8-6-62	450	30	D
16dc	45	145	1	D	9-28-62	75	15	D
18cc		136		D	10-5-57			
18aa		125	Dry	D	7-10-62			
23cb		153	1	D	8-31-61			

Location	Depth to Water	Depth of Well	Capacity Listed	Purpose	Date Appropriated	Water Used	Depth to Water	Purpose Reported
C1-71 - Continued								
25cb	8	39	2	D	11-19-59			
28cd	18	200	3	D	10-7-61	200	-	D
31ab	20	68	7	D	9-10-58	-	65	D
31ad	5	48	2	D	7-12-58			
31ca		40	Dry	D	9-10-62			
31cb	5	60	1	D	8-3-57			
31cc	40	140	1	D	6-20-	100	40	D
31cd	24	50	3	D	12-28-58			
31da	30	98	1	D	8-29-58			
31da2	15	53	2	D	9-6-58			
31db	25	95	1	D	9-14-62			
31db2	15	50	5	D	8-4-61			
31db3	15	40	3	D	6-16-62	2,880	35	D
31dc		70	1	D	8-1-57			
31dc2	45	100	1	D	8-29-60	0	22	-
31dc3	20	200	1	D	7-5-63			
32cb	31	126	1	D	1-21-60			
32cd	30	110	1	D	6-29-57			
32cd2		130	1	D	6-20-57			
32da	60	152	6	D	2-8-58			
32db	35	113	9	D	12-23-58			
32dc	60	200	1	D	1-21-61	20	50	D
32dd	10	113	2	D	4-28-59	5,000	-	D
32dd2	38	140	1	D	6-9-61			
C1-72								
5cb	30	108	1	D	7-25-63	12	40	D
7cc	20	100	6	D	1- -63			
12bd	30	95	2	D	9-3-62	250	85	DI
20dd	80	230	10	D	10-31-62			
23bb	25	95	1	D	6-6-63	-	97	D
27aa	15	125	10	D	7-12-63			
27da		50	60	D	9-12-60			
27db		30	20	D	10-10-57			
27db2	2	6	5	D	6- -53			
28ac	15	51	6	D	12-22-59	5	58	D
29db	12	50	5	D	7-20-63			
30cc	6	70	12	D	12-18-62	200	65	D
31bb	30	200	8	D	8-28-62			
31ca	40	140	1	D	7-10-63	150	145	D
31cb	55	95	2	D	9-13-62			

Location	Depth to Water	Depth of Well	Capacity Listed	Purpose	Date Appropriated	Water Used	Depth to Water	Purpose Reported
C1-72 - Continued								
31cb2	130	155	1	D	11-5-62			
32da	18	40	4	D	10-14-60			
32da2	14	110	2	D	5-16-62			
33ba	21	24	3	D	11-17-62			
33bc	30	68	8	D	7-12-60	150	30	D
33dc	30	125	1	D	7-18-63			
35aa	15	165	10	D	11-10-59			
36ab	35	170	2	D	8-23-60	-	170	D
36ab2	15	65	10	D	10-25-62			
36ab3	25	60	5	D	10-10-62			
36ab4	30	82	9	D	10-26-59			
36ac	8	95	20	D	5-21-61			
36ba	28	83	1	D	9-19-58			
36ba2	25	93	15	D	9-6-62			
36ca	8	50	8	D	8-31-60			
36ca2	35	125	6	D	9-22-62			
36da	10	106	2	D	5-15-59			
36db	14	18	100	D	-27			
36dc	9	45	75	D	9-25-62			
36dc2	38	95	4	D	9-12-61			
36dd	15	40	7	D	6-18-60	-	40	-
C1-73								
13ab	180	230	1	D	6-26-62			
13ab2	15	80	1	D	10-4-60	-	40	D
13ba	100	140	33	D	8-5-61			
21bb	20	55	10	D	7-24-63	25	20	D
21bb2	-	-	-	D	8-31-59			
21bd	17	25	3	D	7- -55			
21bd2	18	27	3	D	6-11-63			
21db	10	25	12	D	12-4-59			
21dd	34	63	2	D	7-16-63			
35cc	10	80	25	D	11-21-59	100	75	DI
36ac	37	40	2	D	5-17-58			
36ad	40	100	3	D	9-13-58			
36ad2	30	79	5	D	7-8-60			
36ad3	30	150	6	D	12-31-62			
36ad4	30	95	2	D	12-28-62			
C2-71								
4cb	3	140	7	D	10-29-59			

Location	Depth to Water	Depth of Well	Capacity Listed	Purpose	Date Appropriated	Water Used	Depth to Water	Purpose Reported
C2-71 - Continued								
4cb2	12	125	1	D	12-26-61			
4cc	35	125	5	D	12-17-62			
4cc2	72	105	1		7-28-61			
4cc3	60	200	1	D	5-26-61			
4cc4	35	90	1	D	2-10-58			
4cc5	15	160	2	D	12-12-59	3,000	110	D
4cc6	10	50	3	D	8-12-60			
4cc7	20	40	8	D	7-6-63			
4cd	5	95	6	D	7-10-58			
4cd2	20	28	2	D	7-21-57			
4dc	10	25	2	D	7-27-57			
5aa	35	95	2	D	1-17-61	800	21	DI
5ab	20	50		D	8-16-62			
5ab2		150	Dry	D	8-2-57			
5ab3	4	110	1	D	5-27-61			
5ac	60	144	1	D	8-11-58			
5ac2	10	50	3	D	2-4-61			
5ac3	14	51	1		11-16-61			
5ac4	25	200	1	D	9-20-62			
5ac5	50	98	1	D	8-20-58			
5ba	25	83	1	D	8-19-61			
5ba2	16	67	1	D	9-1-61			
5bd	16	62	2	D	10-18-61			
5ca	30	125	1	D	8-3-63			
5ca2	5	82	1	D	11-24-59			
5ca3	30	110	1	D	1-13-61			
5ca4	5	128	2	D	4-26-59			
5cd	30	125	1	D	8-15-62			
5cd2	6	12	15	D	4- -60			
5cd3	18	125	1	D	8-18-60			
5da	55	194	1	D	12-21-62			
5da2	12	110	1	D	12-20-61	250	3	D
5da3	25	67	2	D	11-6-59	30,000*	425	D
5db	5	187	1	D	1-9-63	1,000*	8	D
5db2	9	45	1	D	4-14-58			
5dc	22	86	1	D	4-16-58			
5dd	110	90	2	D	5-26-61			
5dd2	6	140	1	D	6-5-61			
6aa	20	80	2	D	6-17-59			
6ac	35	180	2	D	1-6-63			
6ad	40	135	1	D	8-19-59	100	120	DI
7bc	35	138	1	D	3-12-62			

Location	Depth to Water	Depth of Well	Capacity Listed	Purpose	Date Appropriated	Water Used	Depth to Water	Purpose Reported
C2-71 - Continued								
7ca	7	50	3	D	10-8-62			
7ca2	10	67	1	D	8-4-60			
7cb	30	97	1	D	6-15-60	-	28	DI
8aa	6	14	2	D	6-12-61			
8ab	20	50	1	D	8-11-61			
8ab2	8	80	3	D	5-25-62			
8ac	50	200	1	D	9-28-62	312	125	D
9ad	12	45	1	D	1-12-58			
9ba	2	90	1	D	10-22-58			
9bb	12	82	1	D	8-3-60	100	30	D
9bb2	20	245	1	D	1-6-61			
10cc	10	23	4	D	8-5-51			
10cd	9	77	5	D	4-14-62			
15bc	17	38	1	D	9-17-59	150	27	D
C2-72								
3bc	10	20		D	7-1-59			
3ca	40	205	15	D	9-23-60			
3ca2	50	125	2	D	9-19-60	2000	45	D
4bc	40	111	2	D	10-3-60	10	40	D
4bd	20	95	2	D	7-19-63			
6ba	40	240	1	D	6-24-59	2500	190	D
6ba2	80	170	3	D	7-7-61			
6bd	35	110	1	D	8-25-59			
6bd2	25	83	6	D	8-29-59			
6bd3	40	170	2	D	7-12-61			
7da	20	66	1	D	9-1-59			
7dd	50	166	1	D	7-29-61	300	150	DI
8aa	4	35	22	D	9-25-61			
8aa2	10	28	2	D	5-17-58			
8aa3	19	83	2	D	8-26-58			
8aa4	12	38	1	D	5-9-58			
8aa5	15	65	6	D	7-14-61			
8aa6	30	155	4		8-29-62			
8ab	10	35	5	D	8-28-62			
8ad	32	85	1	D	10-30-62			
8bc	48	117	1	D	9-8-61			
8bc2	20	80	4	D	9-10-61			
8bc3	20	70	2	D	5-1-59			
8ca	19	53	10	D	5-11-59			
8ca2	15	38	20	D	5-6-59			

Location	Depth to Water	Depth of Well	Capacity Listed	Purpose	Date Appropriated	Water Used	Depth to Water	Purpose Reported
C2-72								
8ca3	15	40	2	D	6-12-63			
8ca4	15	122	3	D	5-8-62			
8cc	10	30	1	D	8-19-57			
8da	54	134	4	D	6-9-63			
8db	10	50	1	D	8-3-61			
10cd	65	200	30	D	8-10-61			
10cd2	7	21	10	D	6-11-60			
12ab	15	67	2	D	1-30-58	1000	15	DS
17aa	16	50	2	D	12-13-61			
17aa2	92	105	3	D	-59			
17ac	20	70	20	D	7- -48			
17ac2	57	14	18	D	8-22-57			
17ad	36	30	12	D	8-21-57			
17ad2	26	42	2		11-8-57			
17bb	22	125	2		6-5-63			
17bc	25	110	12		2-14-61			
17ca	30	67	18		6-22-60			
17ca2	6	33	2		6-23-60			
17ca3	25	67	3	D	6-28-60			
17ca4	30	127	1	D	7-1-60			
17ca5	12	80	1	D	2-7-61			
17ca6	6	33	2	D	6-23-60			
17ca7	15	80	4	D	6-7-62			
C2-73								
1bb	25	32	7	D	10-24-62	50	28	D
1bb2	20	41	5	D	9-26-62	-	32	D
2ac	14	56	5	D	6-23-58	50	50	D
12ac	22	70	3	D	4-28-62			